PRODUCT ENGINEERING

JANUARY, 1945

In this Issue: Design of Castings

R V16 Jan-Apr. 1945

Lengthen Service Life

...regardless of unit size!

4 TIMES LONGER LIFE

Eight years' service instead of two, was obtained by a large chemical company through specifying Nickel cast iron in this 8-ton ring. Plain iron used here corroded and eroded ½" per year. This Nickel alloyed iron wears less than ⅛" in the same time.

Increases Result/Dollar Ratio...

In products and applications . . . from a wrench to a railroad . . . records show that a little Nickel goes a long way to lengthen product life, to reduce bulk and deadweight, and to save maintenance costs.

When compared with costs involved, metals to which Nickel is added invariably rise sharply in service value . . . due to improved performance.

Nickel imparts strength, hardness, toughness, resistance to corrosion, heat and abrasive wear. In all fields of industry Nickel offers significant advantages. Send us details of your problem for our recommendations.

THE INTERNATIONAL NICKEL COMPANY, INC.

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VOLUME XVI — JANUARY, 1945 — NUMBER 1

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IN THIS ISSUE

Cover Picture—Tapping 15-ton heat from an electric furnace in steel foundry at General Electric's Schenectady Works. Photo by Ray Hahn, General Electric Company News Bureau Photographer.

American-British Engineering

A comparison of the engineering concepts of American and British scientists is presented in an article starting on page 1, by G. Geoffrey Smith, M.B.E., British authority on

scientific and engineering accomplishments, who has traveled extensively in this country during the past six months as emissary of the British Supply Council for the interchange of technical information. His review of the world-shaking achievements of American and British engineers in helping to overcome the aggressions of the common enemy, and his recommendations on the future relationships between British and American engineers are worthy of serious consideration.

"Super-Aluminum" Alloys

New high-strength aluminum alloys having tensile strengths from 65,000 to 78,000 lb. per sq. in. and high compressive yield strengths have come into use in the past three years, primarily in aircraft. In an article on page 6, two Consolidated-Vultee engineers discuss these materials with reference to strengths, heat-treatments, design working stresses and corrosion resistance.

Hydraulic Systems—I

A series of articles, prepared by Howard Field, Jr., discussing the construction, characteristics, advantages and limitations of hydraulic pumps, packings motors, cylinders, power systems, accumulators, special circuits and valves will appear in successive issues. The first article on page 22 reviews types of pumps used and their inherent characteristics.

Designing Castings for Highest Quality

A foundryman is in the best position to anticipate the location and nature of possible flaws caused by improper design of the casting. J. A. Wettergreen, superintendent of foundries and pattern shop, General Electric Company, see page 27, sets forth a few observations and design rules for the guidance of engineers, which if observed, will result in high quality castings and reduce costs.

Wire Stitched Joints

Wire stitching for joining light metal sheet and other materials, has undergone extensive tests by Bell Aircraft Corporation, whose engineers have made corrosion and strength tests of stapled joints in various gages of aluminum alloys. An article on page 38 reviews the test data.

Forces in Multicylinder Gear Drives

The mathematical approach in determining the magnitude of balanced and unbalanced moments and forces present in drives consisting of several slider crank mechanisms used to turn a central gear, is explained by Sergei G. Guins, analytical engineer, Curtiss-Wright Corporation, see page 40. The method is applicable to other types of machinery.

O-Rings for High Pressures

O-ring packings, rings of circular cross-section, heretofore used in reciprocating hydraulic equipment only for pressures below 1,500 lb., have now been developed for use at double this pressure. Their design and application, developed by Lockheed Aircraft Corporation, is described starting on page 56 in an article by Richard L. Hayman.

Automatic Feed Mechanisms

Mechanisms that feed materials or parts into and through machines for processing operations, must vary greatly in their design because of differences in conditions under which they are used, differences among parts or materials to be processed, and differences in processing operations. A few of the endless variety of feed mechanisms are illustrated on page 44 and 45.

Strength of Screw Lap Joints

Designs of countersunk screw lap joints have been found to fail at considerably less than their calculated loads. An article on page 46 by T. R. Rieben and C. J. Spengler, structural test engineers of the Boeing Aircraft Company gives data from their investigation showing advantages in the use of recessed head screws rather than slotted head screws.

Aircraft Electrical Equipment

A continuation of the article "Electrical Equipment Developments as Influenced by Aircraft Design," PRODUCT ENGINEERING, December, 1944, Lt.-Col. T. B. Holliday, engineering division, equipment laboratory, Wright Field, see page 49, discusses the requirements of aircraft electrical accessories, the progress that has been made in their design and performance.

Sealants for Castings

Suitable sealants to overcome various types of porosity in castings, have been developed. These sealants and methods of application are described briefly in the article beginning on page 53, by R. W. Crawford and Sanford E. Glick of Monsanto Chemical Company.

Fillet Proportions for Stepped Shafts

Four sets of curves which give the sizes of fillets to use at the shoulders of stepped diameter shafts to obtain stress concentration factors of 1.5, 2.0, 2.5 and 3 respectively, were contributed by Arthur M. G. Moody, chief research engineer, De Laval Steam Turbine Company. See pages 71 and 72 in the Reference Book Sheet section.

FEBRUARY HIGHLIGHTS

Stainless Steels. A 16-page special insert featuring available alloys, properties, and new applications.

Thermal Resistors, by R. S. Goodyear of Western Electric. Discussing certain metallic oxides as temperature-sensitive resistance elements.

Organizing Our Knowledge of Materials, by B. C. Boulton. Setting forth a basis for organizing and correlating engineering data.

Heavy Stampings. An editorial summary of wartime developments that point to postwar probabilities.

Spotwelds in Aged 24S, by M. L. Ochieano of Lockheed. Includes tensile and shear strengths and corrosion resistance.

Hydraulic Packings, by Howard Field, Jr. Types of packings, their characteristics and installation.

Flywheels, by Henri Lewin. A simple method for the exact calculation of flywheel energy.

An Open Letter...

TO THE USERS OF STAINLESS STEEL TUBING

SUMMERILL TUBING COMPANY
Manufacturers of Seamless Steel Tubing

BRIDGEPORT, PENNSYLVANIA

R. R. LAWSON, EXECUTIVE VICE PRESIDENT

December, 1944

For nearly five years SUMMERILL'S full production of Stainless Steel Tubing has been going to our Military Services in untellable millions of feet. Various shapes ranging from ½" OD down to tiny capillary sizes are in use throughout the world as signal antennae, frames for "Gibson Girl" kites, hypodermic needles—instruments and arms—aircraft engines and automotive equipment

The application range of Stainless Steel Tubing has been so expanded during the war years that there is little doubt as to future demands for this versatile material

As proof of our faith in this forecast, we are well along on plans for materially increasing our production facilities. These plans include new equipment and facilities designed for drawing larger sizes—new shapes—new types and finer finishes

You can continue to look to SUMMERILL for leadership in the Stainless Steel Tubing field

Very truly yours,

R. R. Lawson

Executive Vice President
SUMMERILL TUBING COMPANY

P.S. It would help in our planning if you would write us regarding the sizes and types of Stainless Tubing in which you might be interested.

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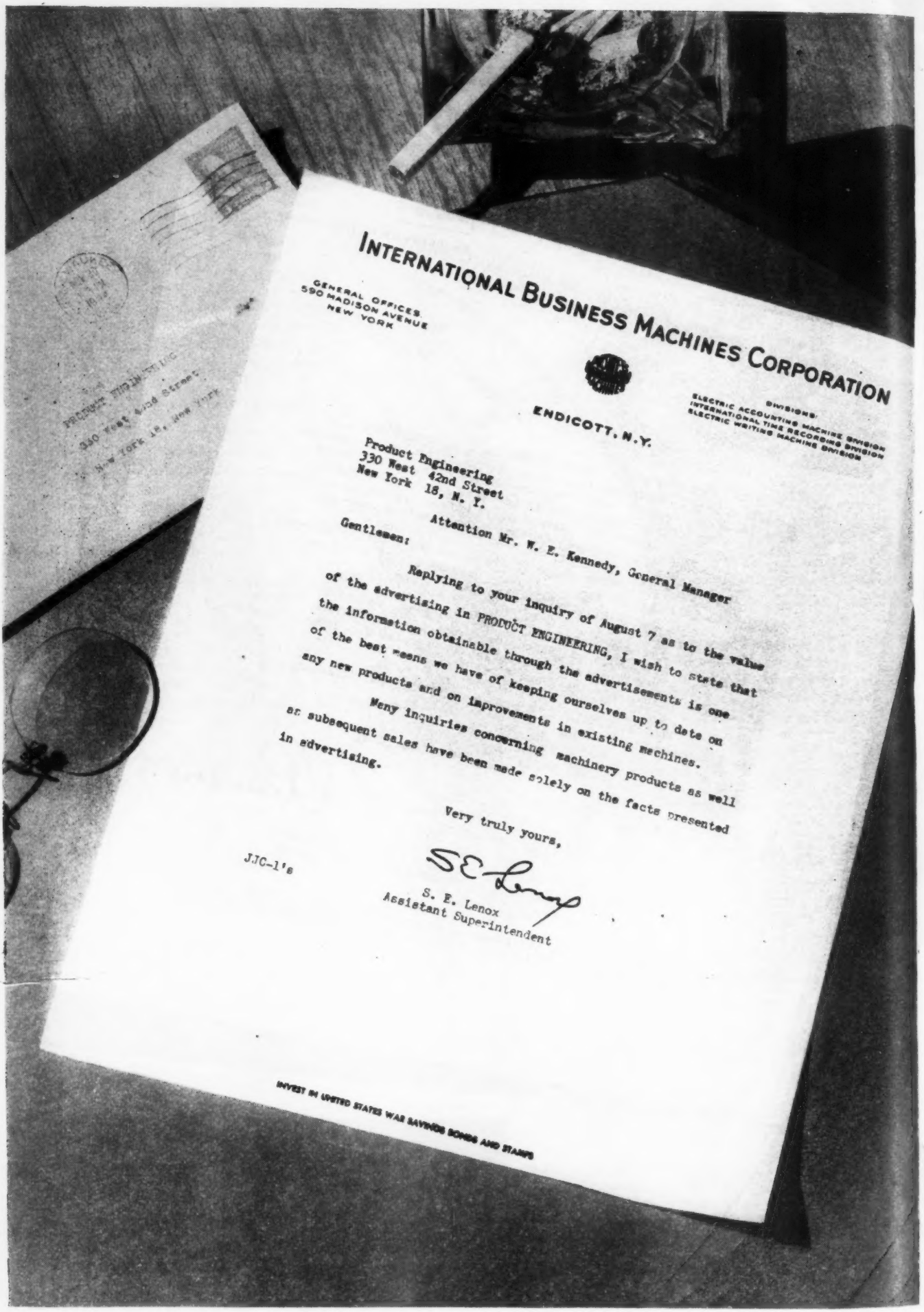
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Attention Mr. W. E. Kennedy, General Manager
Gentlemen:
Replying to your inquiry of August 7 as to the value of the advertising in PRODUCT ENGINEERING, I wish to state that the information obtainable through the advertisements is one of the best means we have of keeping ourselves up to date on any new products and on improvements in existing machines.
Many inquiries concerning machinery products as well as subsequent sales have been made solely on the facts presented in advertising.
Very truly yours,
S. E. Lenox
Assistant Superintendent
JJC-l's
INVEST IN UNITED STATES WAR SAVINGS BONDS AND STAMPS

WORKABLE!

Electric Welded Steel Tube by REVERE

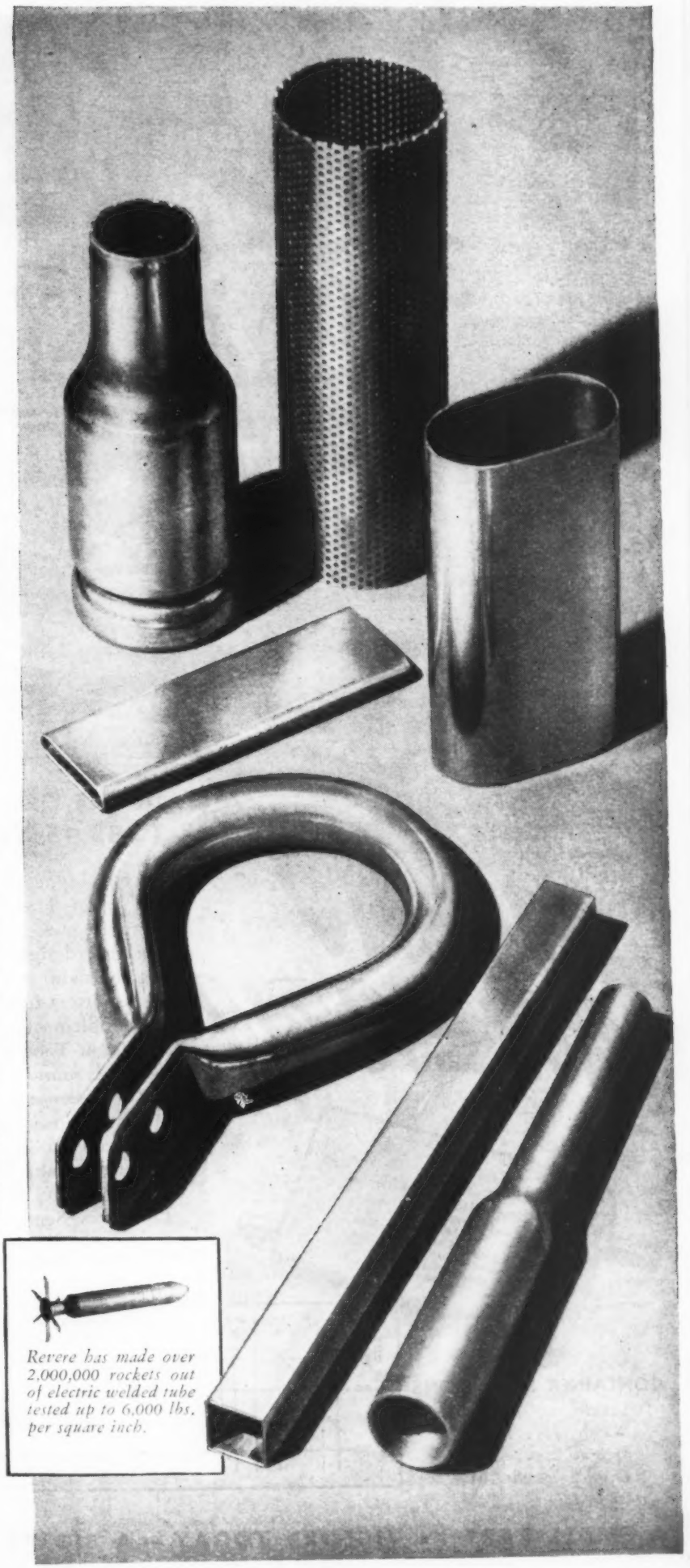
These shapes are just a few of the thousands that have been made of Revere Electric Welded Steel Tube. It is so workable that a great number of parts and products can be made of it. Here are some of the operations customarily performed on these tubes:

Expand	*Plate*
Flange	*Flatten*
Bend	*Taper*
Bead	*Swage*
Machine	*Grind*

Weld

Revere Electric Welded Steel Tube is not just tube. It is available in various exactly-controlled hardnesses, and not only round but in almost any desired shape. It can be supplied in various tempers, annealed or normalized, as required. Dimensional tolerances are held to strict standards. We can so process the tube that it is impossible to ascertain the location of the weld. There is literally a Revere Welded Steel Tube for every steel tube use. Sizes up to 4½ inches O.D., wall thickness up to #7 B.W.G., .180 inch.

We not only supply steel tube in straight lengths, but also fabricate it into parts that will fit into your assembly with little or no additional processing. One customer reports saving $9 per unit when he switched to Revere Electric Welded Steel Tube. For further information write the Revere Executive Offices.



Revere has made over 2,000,000 rockets out of electric welded tube tested up to 6,000 lbs. per square inch.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Ave., New York 17, N. Y.

AWAY AHEAD!

IN THE FIELD OF RADIO NOISE ELIMINATION TOBE IS THE ACKNOWLEDGED LEADER

ONE engineering result of the war is increased knowledge of radio interference problems. It will never be lightly treated again. No engineer can tackle the development of an electrical design without giving due consideration to minimizing the radio interference it creates in operation. Specially designed filters, to be built into electrical circuits, can usually solve the problem of radio interference.

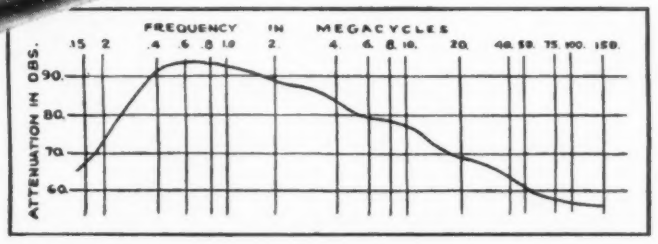
Here at Tobe is a great storehouse of knowledge in this subject. It is *sound* knowledge, gained by the most intense interest and experience of any company in the field.

Tobe Filterizing is a copyright term. It means that Tobe knows how to "filterize" man-made radio noise. Why not make use of this valuable 16 years' of experience in your own engineering? Place your reliance on Tobe and the famous Tobe Filterettes. Send us your problems now.

TOBE DEUTSCHMANN CORPORATION • CANTON, MASS.

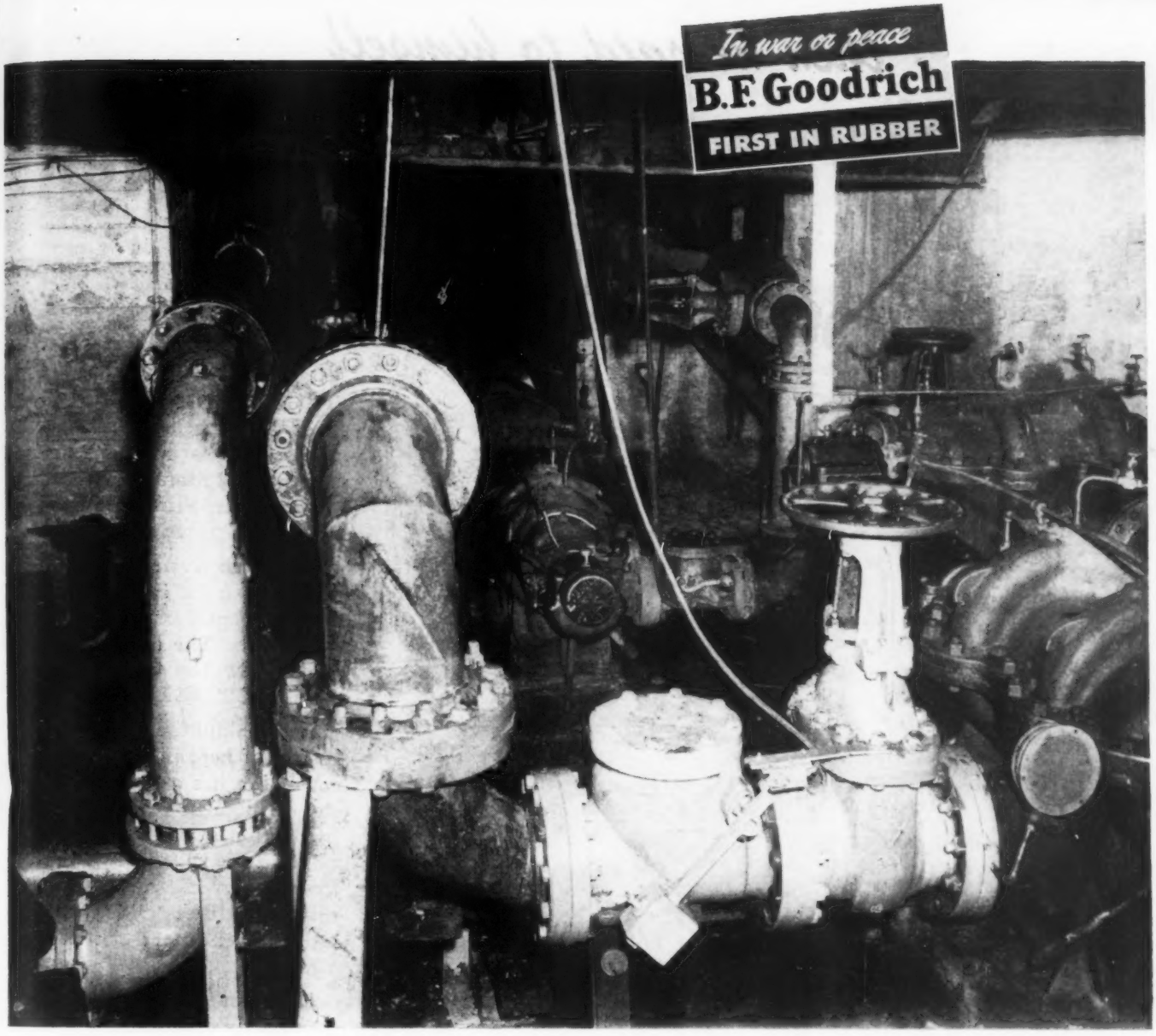
CONTAINER DIMENSIONS

Length .....4 7/16"
Width .....2⅛"
Height .....2⅞"
Overall length..6¼"



SUPPRESS MAN-MADE RADIO STATIC
TOBE FILTERIZED

A SMALL PART IN VICTORY TODAY — A BIG PART IN INDUSTRY TOMORROW



Pipes gulp acid water to save a coal mine

A typical example of B. F. Goodrich development in rubber

AT THIS mine in Pennsylvania there's good coal—450 feet down—but even more water. A few years ago they almost lost the mine—the pipes, for pumping the water out, had corroded, because the water contains acid, and in three days enough water could pour in to flood the underground pumps and lose the mine for months—make salvage almost impossible.

The mine owner had heard that chemical plants use pipe lined with B. F. Goodrich rubber to handle strong acids. He investigated, bought the same pipe, and has never been in danger of losing his mine since. Metal pipe used to last 7 months; the B. F Goodrich pipe has now been in use 48 months and is as good as new. In that time it has handled more than 10 billion gallons of acid water.

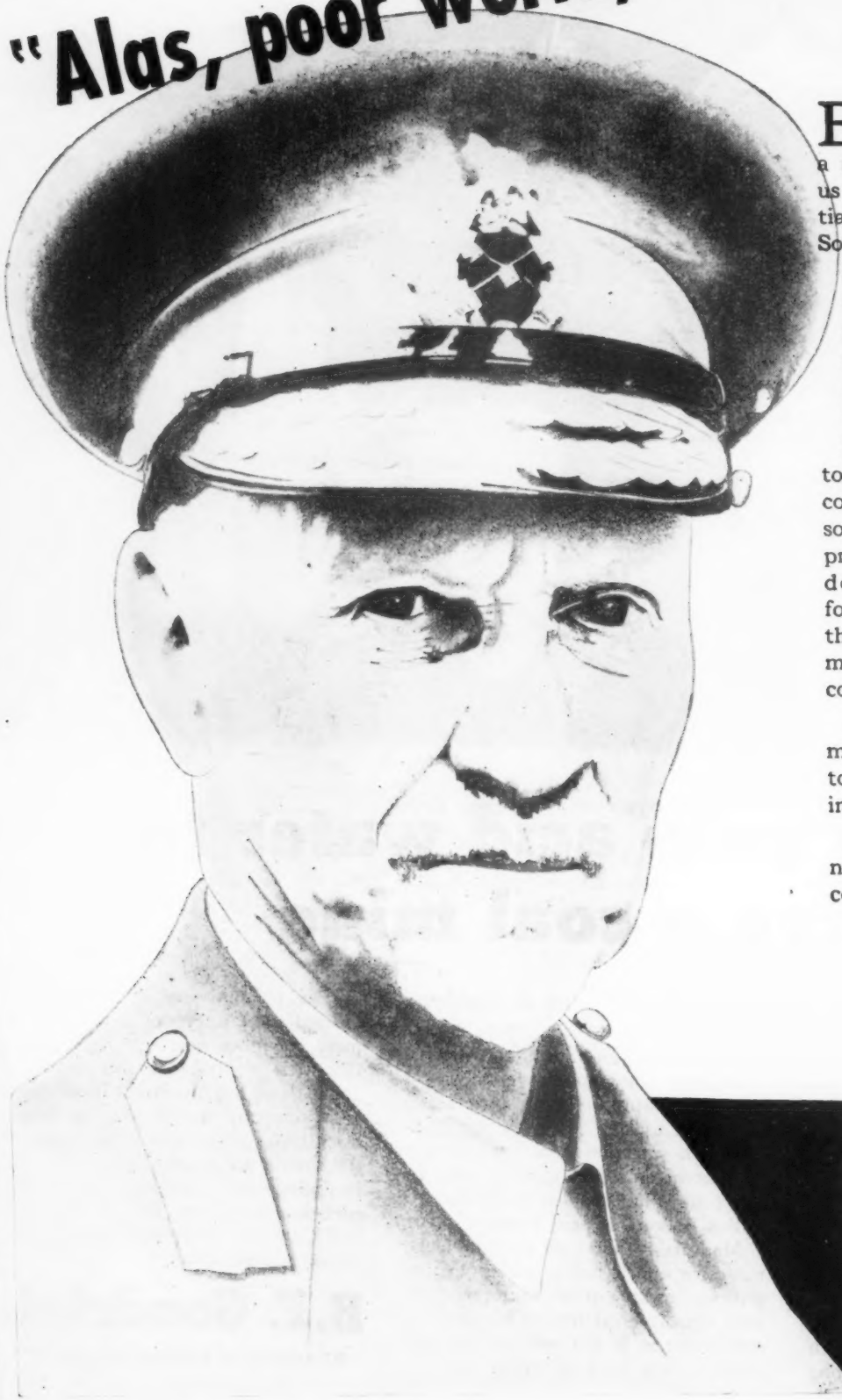
Many B. F. Goodrich developments, made for one industry, are applied as this was to an entirely different field with equally good results. Research is continuous at B. F. Goodrich, and applies to every kind of rubber product, new or old. No product is too standardized to be improved or changed to meet changing needs of users. B. F. Goodrich distributors can tell you about those improvements in products your company already uses or *might* use. If you don't know the name of the distributor nearest you, write direct about any problem you have that rubber might solve. *The B. F. Goodrich Company, Industrial Products Division, Akron, Ohio.*

B.F. Goodrich

RUBBER *and* SYNTHETIC *products*

then he said to himself

"Alas, poor world, I knew it well"



EXPLAINING how the old map is being rolled up and a new map is unrolling before us . . . Field Marshal Jan Christiaan Smuts, Prime Minister of South Africa, went on to warn:

> "We are living in a world where we are **FORCED** to a fundamental revision of old concepts. The old world that we knew has **GONE** and it will **NOT RETURN!**"

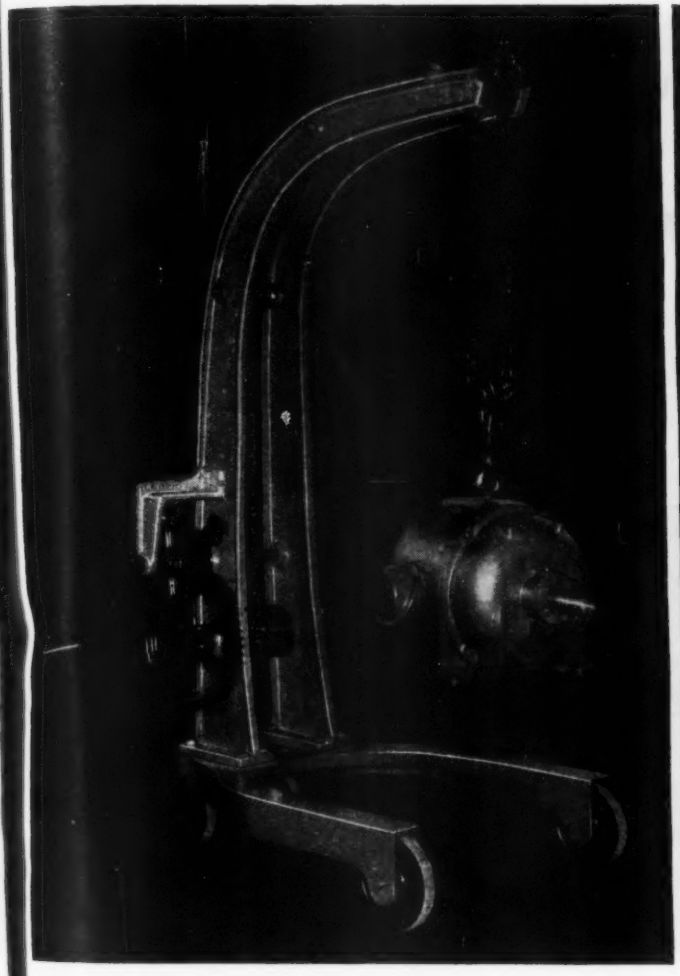
Be thankful that to many factory men here in America that conviction has already been absorbed, because the urgency for production . . . the urgency for development...the urgency for redesign has made evident, throughout these critical supply months, the need for better concepts.

By following old concepts in manufacture, the materiel flowed too little and too late and too ineffectively.

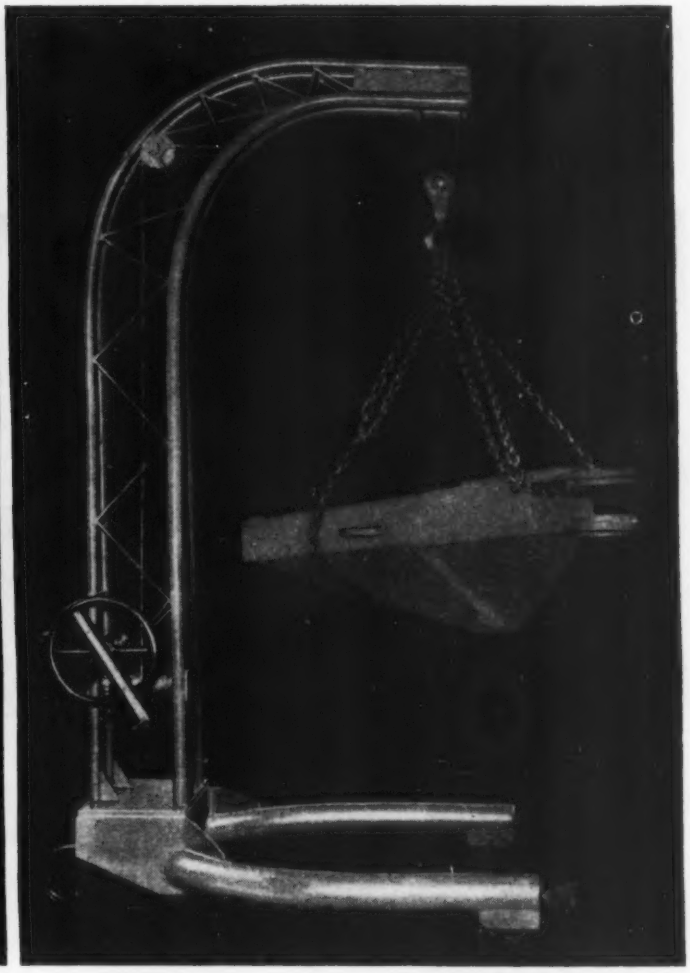
Be thankful for the hundreds of new concepts that are now overcoming our peril. For example:

"A New Map is Unrolling," *he says*

LOOK, MARSHAL SMUTS, how fundamental thinking is revising old concepts in the design of metal products:



THE OLD MAP in the world of Canton portable cranes, manufactured by The Hill Acme Company, Cleveland, Ohio. The former, conventional design of 6000-lb. capacity weighed 2225 lbs.



THE NEW MAP . . . the result of fundamental thinking with welded design. Of the same capacity, it weighs only 1000 lbs. . . . 1225 lbs. lighter. Even a girl can pull this welded steel crane; whereas the former design required two men. A better product . . . made possible by Arc Welding.

The Lincoln Engineer nearby will gladly help you revise old concepts with Arc Welding.

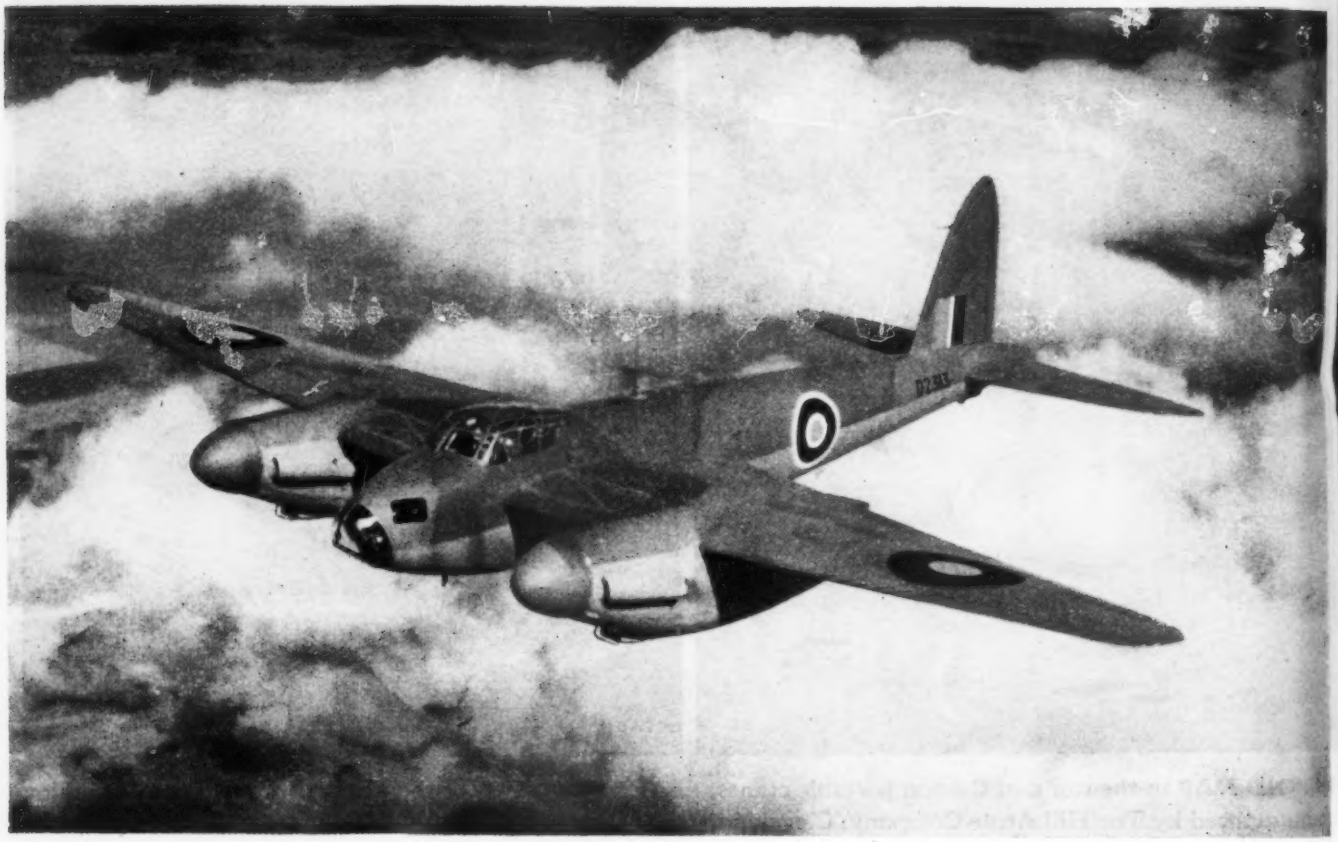
THE LINCOLN ELECTRIC COMPANY, CLEVELAND 1, OHIO

America's greatest natural **recourse**

ARC WELDING

Beetle

...Adhesive Bond for a Bomber



PHOTOS COURTESY DEHAVILLAND AIRCRAFT OF CANADA, LTD.

In the fastest bomber of its day, the famous DeHavilland *Mosquito*, BEETLE*Cements are used to join together all wood in sub-assemblies in the contruction of the wings and fuselage.

A bond stronger than the wood it unites—this cold-setting resin adhesive was especially developed for the assembly of just such composite wooden structures where all types of joints are encountered—particularly in assembly gluing where complex shapes prohibit perfect joining and uniform high pressures are not applicable to insure thin glue lines. In wood construction, such as prefabricated arches, beams, trusses, wooden truck and bus bodies, boats, furniture, and other wood products, these modified cold-setting adhesives permit economy in toolage, while providing strength and durability.

BEETLE Cements are but part of Cyanamid's complete line of hot and cold-setting synthetic resin adhesives. If you use resin glues or adhesives, get the facts on Cyanamid's products in this field. There is a wide variety to meet all needs. **Reg. U. S. Pat. Off.*

LIFE ON THE PLASTICS NEWSFRONT

AMERICAN CYANAMID COMPANY · PLASTICS DIVISION
30 ROCKEFELLER PLAZA · NEW YORK 20, N. Y.

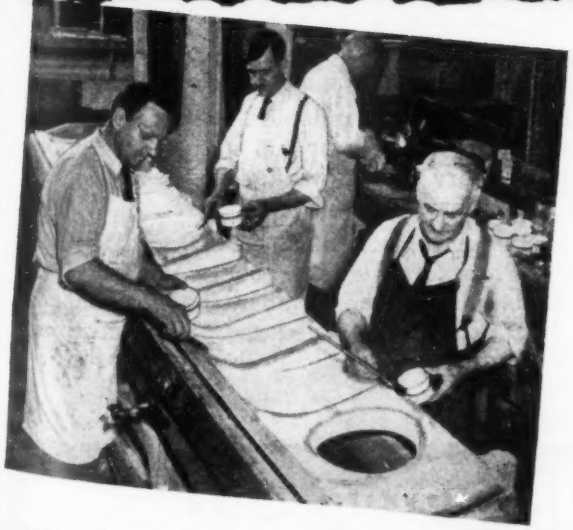
(*Right*) BEETLE Cements, used to assemble bulkhead sealing doors in the *Mosquito* bomber, are modified to eliminate "crazing" and cracking in glue lines.

(*Below*) In such assembly work as the bomber's fuselage shell, glue lines of BEETLE Cement as thick as .020" may be tolerated without sacrifice of dry or wet bond-strength.

Cyanamid Plastics

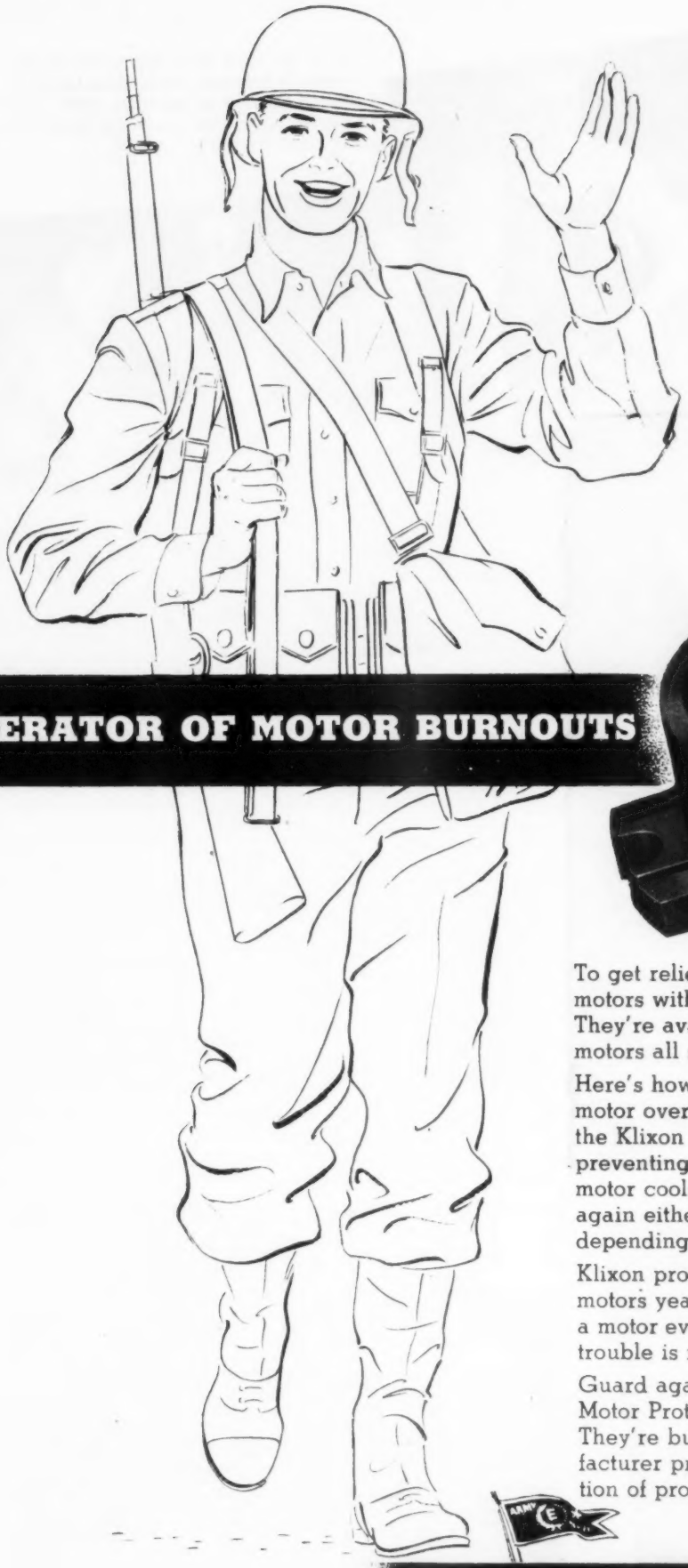
Beetle · Melmac
Melurac · Laminac
Urac

(*Above*) BEETLE Cements form permanent, strong glue lines in assembly work such as the *Mosquito* wings, where perfect joining is difficult to obtain.

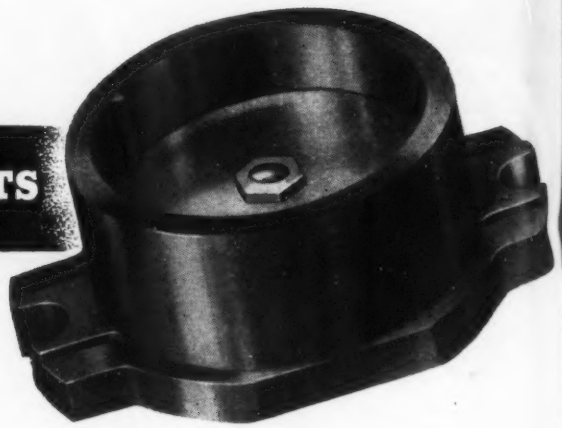


(*Above*) Structural pieces such as those forming the bomb bay door may be assembled with speed and economy with BEETLE Cement.

(*Above*) Where complex shapes like the *Mosquito* fuselage prohibit the application of high, uniform pressures to insure uniformly thin glue lines, BEETLE Cement provides a factor of safety not offered by ordinary urea resin glues.



LIBERATOR OF MOTOR BURNOUTS



To get relief from motor burnouts, always buy motors with built-in Klixon Motor Protectors. They're available as a built-in feature with A.C. motors all sizes; D.C. motors up to 30 volts.

Here's how they insure full motor life . . . when a motor overheats and becomes dangerously hot, the Klixon Protector snaps the power "off" thus preventing a possible burnout. Then when the motor cools sufficiently, it turns the power "on" again either automatically or by manual reset depending on the type of protector you specify.

Klixon protection is reliable . . . it protects motors year in and year out, starting and stopping a motor every time it overheats until the trouble is remedied.

Guard against motor burnouts . . . specify Klixon Motor Protectors with every motor you buy. They're built into the motor by the motor manufacturer providing a tested and proven combination of protector matched to the motor.

KLIXON MOTOR PROTECTORS

SPENCER THERMOSTAT CO., ATTLEBORO, MASS.

Vinylite

TRADE-MARK

Outspinning the spider

The spider is an engineer—a master of construction and design. While man piled massive stone on stone for the pyramids, the spider built with an extruded material of airy lightness and amazing strength—presaged the whole trend of modern practice.

Today, VINYLITE extruded elastic plastics bring this same invaluable combination to wire and cable insulation. With excellent dielectric properties, they permit new thin-wall construction, with notable reductions in the weight and thickness of insulation on electrical conductors. More circuits can be inserted in existing conduits. And to insulation properties unsurpassed by older types, thin-wall insulation of VINYLITE elastic plastics adds unusual resistance to chemicals, oils, grease, and abrasion. It stays flexible at low temperatures – has a very low rate of moisture absorption. Certain types are non-flammable or slow-burning. It can be made transparent or opaque, in an infinite variety of colors.

Insulation made from VINYLITE elastic plastics sets up new standards of life and service for the full range of conductors, from portable cords to power cables. Write Department 10 for booklet VR. It describes all the VINYLITE plastics for wire and cable insulation, and explains the specific advantages of each for different types of application.

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Unit of Union Carbide and Carbon Corporation
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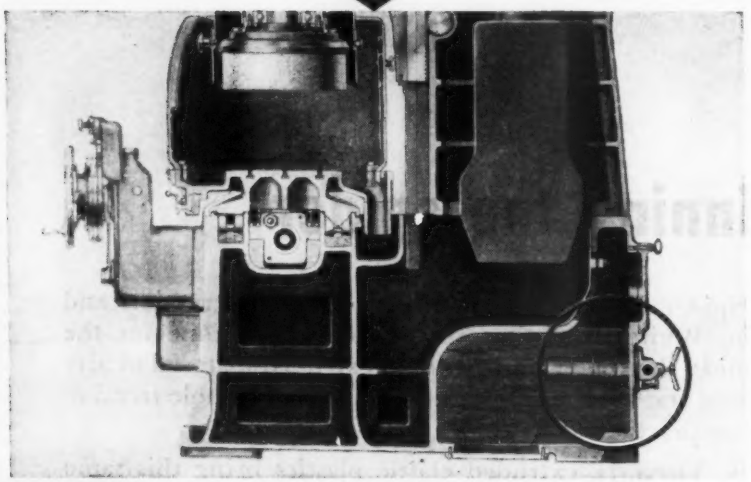
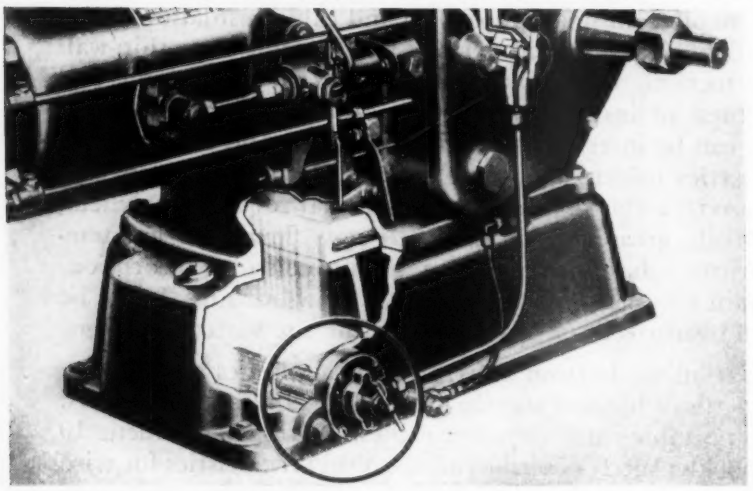
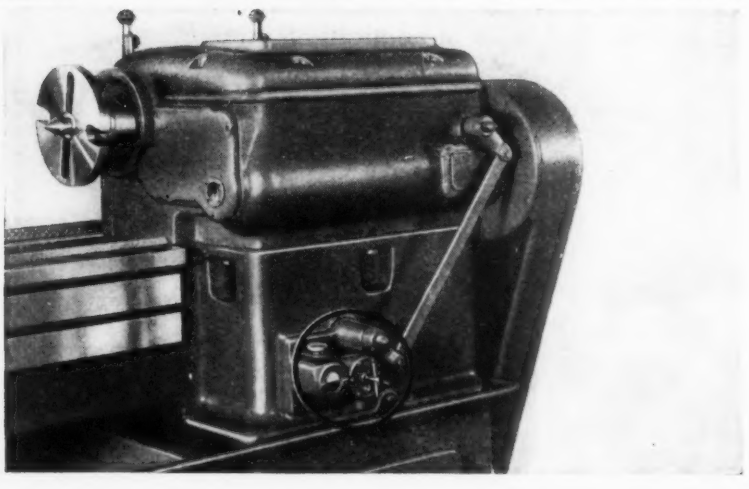
Plastics

YOU CAN HAVE CONTINUOUS F

Built in to machines like this . . . . . r ext





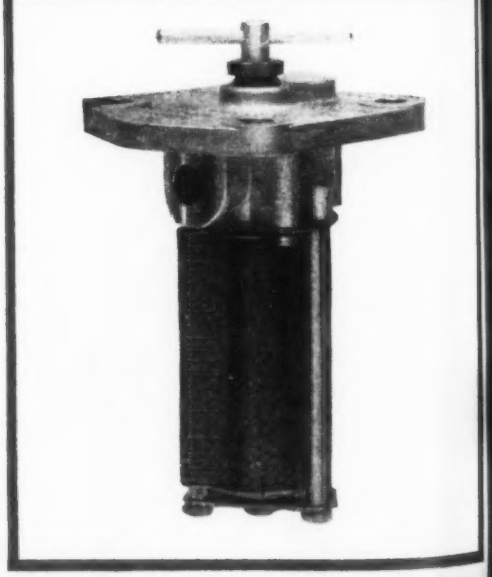


Continuous cleaning of full flow . . . without ever a stop for filter-cleaning — that's the big advantage you can give your machinery . . . or process . . . by having built into it a Cuno Auto-Klean Filter.

If you are designing a new machine, you can plan on fitting the Cuno neatly and conveniently into a chamber in the machine itself. You won't need much room or much piping, because the Cuno is small and compact and its self-cleanable feature makes a space-consuming duplex installation unnecessary. Or, if you want to give existing equipment the advantage of continuous cleaning, the Cuno can be mounted externally, complete with case, and with no need of a by-pass installation.

Cuno gives you continuous cleaning because it is not necessary to interrupt the flow of fluid in order to clean or renew the filter. The cartridge is permanent — an all-metal stack of discs, spacers and cleaner blades, that never need replacement. Merely turning a handle rotates the filter discs past the cleaner blades which comb out the accumulated solids. This is done while the machine is operating.

To make the fluid-cleaning completely automatic, a hydraulic motor may be supplied to rotate the discs continuously.



Cuno "built-in" type filter for installation as an integral part of machine or equipment

FLUID CLEANING

r externally applied with a Filter like this

Complete Cuno filter including sump

POSITIVE FILTRATION

o solids larger than the openings between discs n pass the Auto-Klean filter. Spacing may be as e as 170 mesh equivalent. (Other types of Cuno ters give even finer filtration.)

Pressure drop is low, so the Auto-Klean is ap- icable to low pressure or gravity feed systems as ell as to others.

The Auto-Klean will last as long as the equip- nt on which it is installed.

Sizes range from small 1¼" diam. x ⅞" man- ally-driven cartridges to massive motor-driven odels. Write for "Quick Facts", a free bulletin scribing a variety of applications.

The filter element is a stack of flat, wheel-shaped metal discs, each separated from the next by a thin metal spacer. Discs and spacers are fixed on a central rotatable shaft, with the "spokes" positively aligned so that the open areas between them form channels lengthwise within the cartridge.

Fluid from the inlet surrounds the cartridge and is forced by differential pressure to flow radially through the slots between the discs. Solids larger than the slot openings are retained on the outer edges. The filtered fluid continues up through the central channels to the filter outlet.

To clean the filter, the stack of discs is rotated past knife-like stationary cleaner blades, slightly thinner than the spacers, which extend into the slots as far as the inside edge of the disc rims. All accumulated solids are combed out and settle to the bottom of the sump.

What's new in fluid-cleaning? Send the coupon for "QUICK FACTS"

KEEP FLOW ON "GO" WITH

CUNO

THE "FILTER-FINE" STRAINER

CUNO ENGINEERING CORPORATION
301 South Vine Street, Meriden, Conn.

Please send me a free copy of QUICK FACTS. I am especially interested in the services checked.

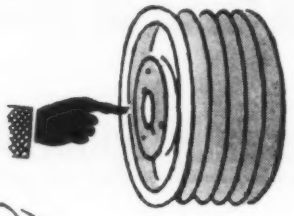
☐Air Actuated Instruments	☐Engines	☐Paper Machinery
☐Air Tools	☐Gear Hobbing Machines	☐Pneumatic Devices
☐Bakery Machinery	☐Grinders	☐Power Transmissions
☐Balers	☐Hobbing Machines	☐Presses
☐Blowers	☐Honing Machines	☐Printing Presses
☐Boiler Feed	☐Hydraulic Systems	☐Pumps
☐Coal Loaders	☐Incubators	☐Radial Drills
☐Coating Machinery	☐Instruments	☐Rolling Mills
☐Combustion Equipment	☐Lathes	☐Scrap Balers
☐Compressors	☐Lubricating Systems	☐Spray Systems
☐Controls	☐Machine Tools	☐Superchargers
☐Cooling Systems	☐Meters	☐Tapping Machines
☐Crushers	☐Milling Machines	☐Test Stands
☐Diesel Engines	☐Oil Burners	☐Turbines
☐Dip Tank Systems	☐Oil Well Drilling Equipment	☐Turret Lathes
☐Drilling Machines	☐Paint Spray Systems	☐Welding Machines

Name .....

Company .....

Address .....

See how Easy it is to put this



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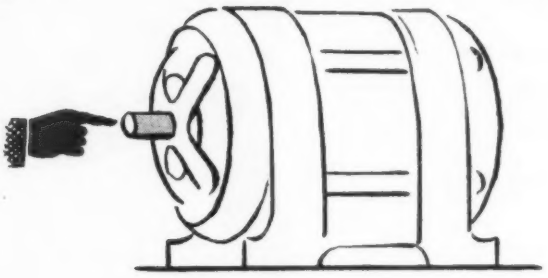
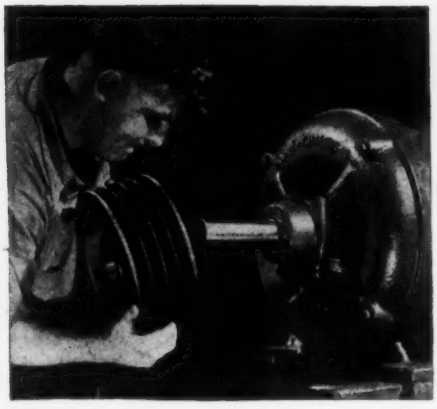
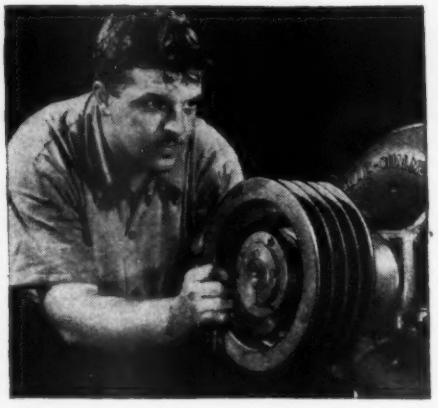


One quick operation and Allis-Chalmers' new "Magic-Grip" — *fastest mounting sheave on the market* — is locked securely to shaft... saving you time, money, trouble!



1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.



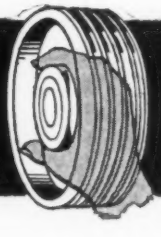
2 Slide to desired position. Sliding easily, sheave can be placed *exactly* according to straight-edge ... giving you true alignment with resulting smooth performance. A minimum of time is required.

3 Tighten three capscrews — and it's ready to go! Entire sheave is locked securely to shaft and *grips like magic!* No set screws to damage shaft. Send for Bulletin B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1750

Allis-Chalmers Texrope

"MAGIC-GRIP"



SHEAVES

If this is what you want in a

CASTING SEALANT...

high sealing efficiency

clean surface after application

resistance to gasoline, other solvents

easy handling in plant or foundry

excellent stability under operating conditions

...HERE'S NEWS

you've been waiting to hear!

MONSANTO Plastics research laboratories have developed a group of highly effective new casting sealants which can be applied with the same equipment and virtually the same methods as with tung oil.

High Sealing Efficiency

The new Monsanto sealants, compounded from a viscous, thermosetting base resin and styrene monomer, have a high sealing efficiency for four basic reasons.

1. They have low viscosity to ensure thorough penetration of the finest pores.
2. They contain no solvents to form vapor or air voids.
3. They are polymerized rapidly by a low temperature bake.
4. They form a rubbery, nonporous solid with excellent adhesion to metal when polymerized or cured in the pores.

Good Chemical Resistance

Because the new Monsanto sealants are thermosetting (i.e. once cured, they will not soften again when exposed to heat) they have good thermal stability. When cured, they are insoluble in aromatic high octane gasoline, lubricating oil, ethylene glycol, isopropyl alcohol and water.

Types Available

Two types of the new Monsanto sealants have been developed and thoroughly proved in foundry tests:

X-117 for magnesium castings
X-118 for both magnesium and aluminum.

A third type is now being tested:
X-119 for iron castings.

Leave Clean Surface

All three types can be applied by vacuum pressure impregnation or by positive pressure with few changes in the standard tung oil processing technique.

After impregnation the uncured resin is easily cleaned from the surface of the casting because its low viscosity permits complete drainage and any remaining surface resin dissolves readily in kerosene dip. Its rapid gel time and freedom from solvents minimizes exudation during cure, leaving clean surfaces.

Easy to Handle

The new Monsanto sealants are supplied as a mixed impregnating solution or as a base resin to be mixed with styrene monomer. Pre-mixed sealants are simple and easier to handle in the foundry and their uniformity is assured by control laboratory tests before shipment.

For full details and technical help in adapting the new Monsanto casting sealants to your operations, write or wire: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield 2, Massachusetts.

The broad and versatile Family of Monsanto Plastics includes: Lustron polystyrenes • Cerex heat resistant thermoplastics • Vynate vinyl acetals • Nitron cellulose nitrates • Fibestos cellulose acetates • Resinox phenolics • Resimene melamines. Forms in which they are supplied include: Sheets • Rods • Tubes Molding Compounds • Industrial Resins • Coating Compounds • Vuepak rigid, transparent packaging materials.

MONSANTO PLASTICS

SERVING INDUSTRY...WHICH SERVES MANKIND

 DETROIT PUBLIC LIBRARY

INTEGRITY...

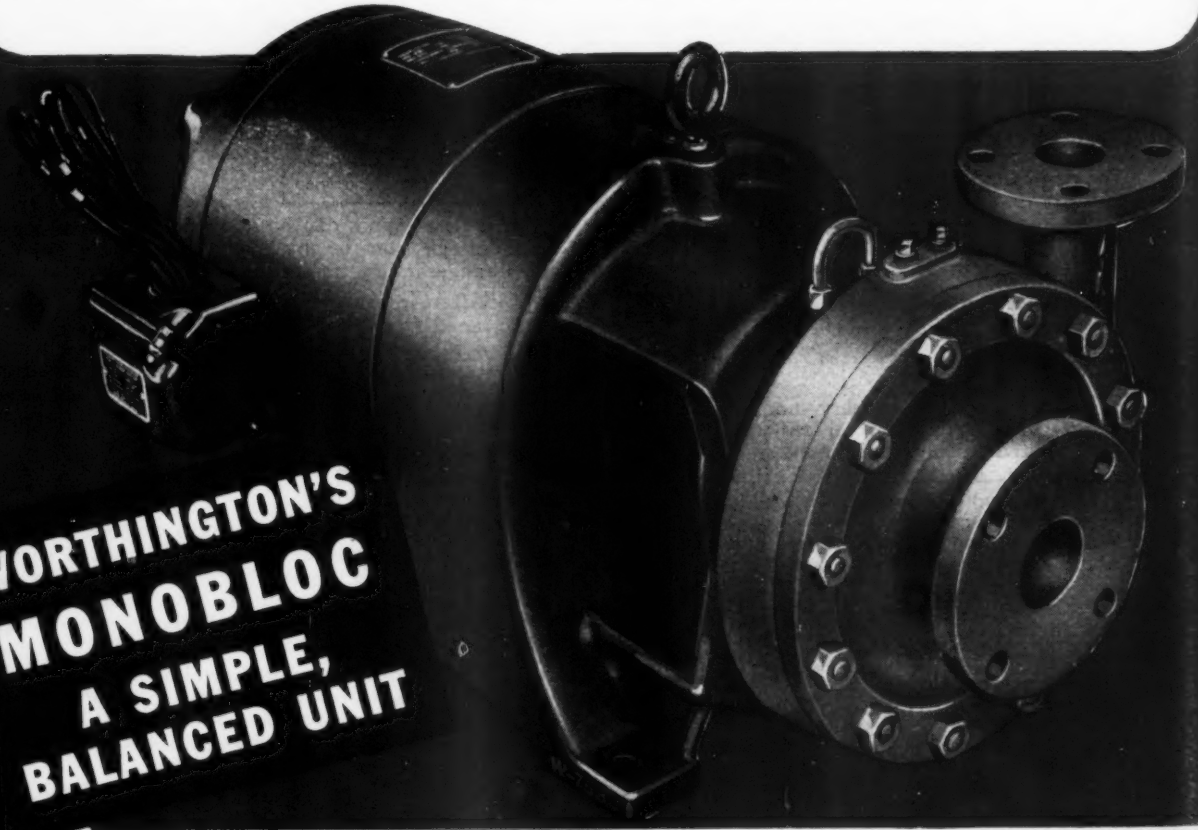
FROM THE DRAWING BOARD TO YOU

Worthington offers a complete line of truly balanced electric-driven centrifugal pump-and-motor units of the Monobloc type . . . each planned as an integral unit on the drawing board. There's integrity, also, in each unit's precision workmanship, based on more than 100 years of pump-making leadership.

The perfect balance of Worthington's MONOBLOC Pump-and-Motor Units pays off in quieter operation, more efficient service, longer life. Specifically, shaft distortion is prevented . . . bearings saved . . . no separate piece is required between pump and motor . . . nor is a base plate needed, even on the larger sizes.

Capacities? Monobloc Pumps cover a complete range — 10 to 1,600 gallons per minute . . . in heads from 15 to 500 feet . . . in motor horsepower from ¼ to 60. Write for Bulletins W-321-B14 and W-321-B15 which give complete details of Worthington Monobloc's exclusive features and advantages.

Worthington Pump and Machinery Corporation, Standard Products Division, Harrison, New Jersey; District Offices in Principal Cities.



WORTHINGTON'S MONOBLOC A SIMPLE, BALANCED UNIT

Centrifugal Pumps | Rotary Pumps | Steam & Power Pumps | Liquid Meters | Vertical & Horizontal Compressors | Multi-V-Drives | Variable Speed Drives

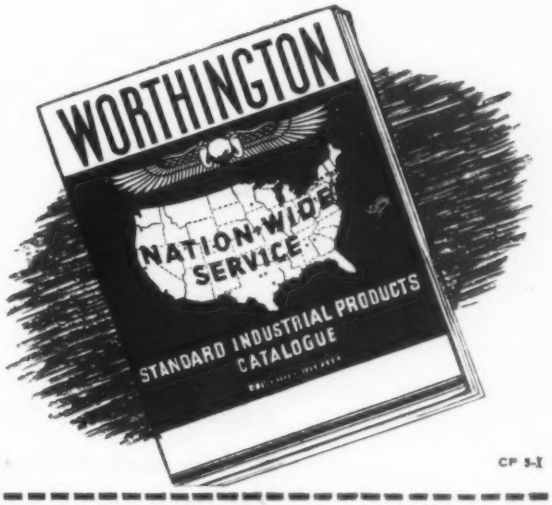
12 GOOD REASONS AND TRUE FOR SPECIFYING WORTHINGTON MONOBLOC

1. Proper hydraulic design for maximum gallons per horsepower.
2. Long continuous service built into pump by correct design and materials.
3. Hand-finished and balanced impeller — securely keyed to shaft for rigidity.
4. Hydraulic balance relieves pressure on stuffing box and reduces thrust.
5. Shaft sleeve extending through stuffing box protects shaft from wear.
6. Proper-controlled flow of ventilating air prevents moisture from being drawn into motor.
7. Extra high motor support prevents floor flooding.
8. Extra large diameter shaft prevents deflection in any moving part.
9. Extra large bearings — ample capacity even for vertical operation.
10. Solid front head on motor with trough prevents drip from entering bearing.
11. Composition water slinger — will not cut hands.
12. Extra strength, base, motor end bell and pump bracket in one piece.

WE KEEP TABS on this Worthington Catalog . . . to Give You Quick, Specific Information

Send for the catalog of Worthington Standard Industrial Products . . . 180 pages of conveniently tabbed engineering data, formulae, charts, rating tables, and other useful information about Worthington Pumps (Centrifugal, Rotary, Steam and Power), air compressors, liquid meters and other Worthington products.

Mail the coupon for this catalog today — it is well worth the moment's effort.



CP 5-I

BEHIND THE NAME
WORTHINGTON

Standard Products Division
Worthington Pump and Machinery Corporation
Harrison, New Jersey

Gentlemen:—Please send me your 180-page Worthington Standard Industrial Products Catalog.

NAME.....

FIRM.....

STREET.....

CITY..... STATE.....

design with magnesium

FABRICATED BY ALL USUAL METHODS

1—SAND CASTING

2—PERMANENT MOLD CASTING

3—DIE CASTING

4—ROLLED SHEET, PLATE AND STRIP

5—EXTRUSIONS: ROD, BAR, TUBING, SPECIAL SHAPES

6—FORGINGS BY PRESS OR HAMMER METHODS

7—FORMED BY BENDING, DRAWING, PRESSING, SPINNING

8—BLANKED, PUNCHED OR SHEARED

JOINED BY ALL COMMON METHODS

RIVETING

ARC WELDING

SPOT WELDING

GAS WELDING

FLASH WELDING

DESIGN NOTES ON FORMING (NO. 7)

Methods employed for forming magnesium compare with those used for other metals. Magnesium, however, is usually formed at elevated temperatures—offering several advantages over cold working. Magnesium parts are usually joined in a single operation—there is no need for repeated annealing and redrawing. Thus not only is time cut in making the part, but the need for additional die equipment for drawn parts is eliminated. Hot forming also permits the reduction of allowances for springback. When forming at 600° F. no springback allowance is necessary. At lower temperatures, allowances depend upon the type of alloy, thickness of material, radius of bend and forming temperature.

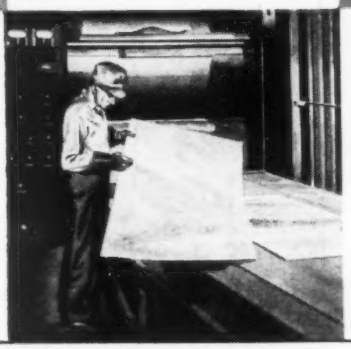
Magnesium Alloy sheet can be blanked, punched and sheared much the same as other metals. Complete data on these and other operations are available to you.

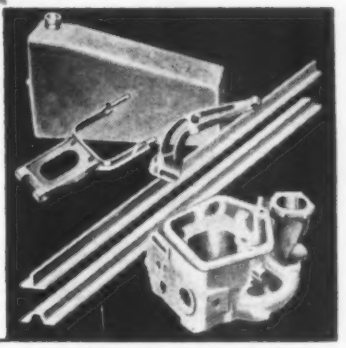
DOW'S LONG EXPERIENCE WITH MAGNESIUM IS AVAILABLE TO YOU—*CONSULT WITH DOW*

—Versatility gives you complete freedom

Magnesium alloys are fabricated and joined by all common methods

They bring new lightness to products of nearly every size and shape





When you turn to magnesium alloys today, you can be sure of this: Whatever your plans call for, these lightweight alloys can be fabricated by practically all of the known methods; for the techniques of processing magnesium are very similar to those used for other metals. Most common of these shop processes are listed on the opposite page.

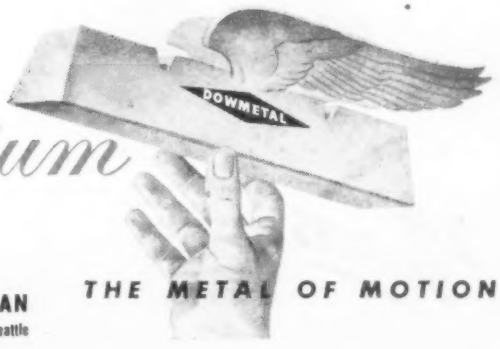
This versatility of fabrication gives you complete freedom in design. It enables you to plan for weight saving, simplified construction and decreased vibration in rapidly moving parts, reciprocating machinery —and almost all other products that move—or must be moved.

Magnesium—*the metal of motion*—is now available in unlimited quantities for your immediate use.

DRAW ON 29 YEARS' EXPERIENCE

Your ideas for new lightweight products can easily become finished magnesium products. Dow engineers and fabrication plants—backed by 29 years of unmatched experience—are ready to work with you. Get in touch with your nearest Dow Sales Office for direct and personalized assistance.

DOWMETAL *magnesium*



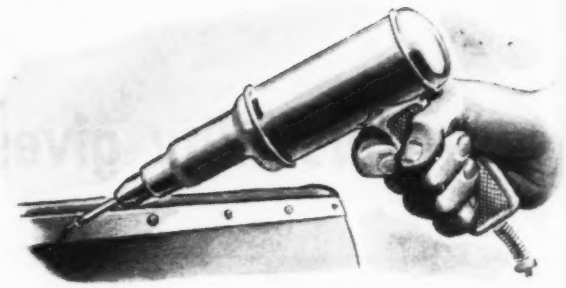
THE METAL OF MOTION

MAGNESIUM DIVISION, THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle

IT'S A TIME SAVER!

So long as his plant stuck to slotted screws, this assembly man had to stick to hand driving. Too much danger of power drivers skidding and gouging the carriage's finished surface – making costly refinishing necessary.

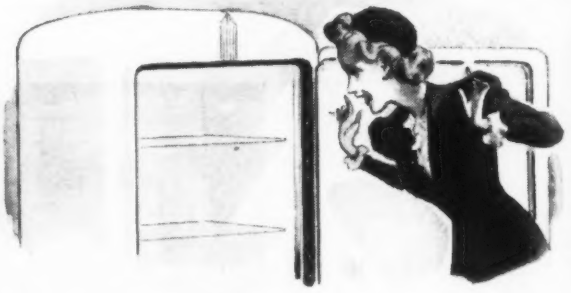


IT'S A MONEY SAVER!

A shift to Phillips Screws permitted a switch to power driving. Thanks to the Phillips Recess, driver skids stopped. Result: a fast, money-saving process instead of a slow, high-cost hand operation!

IT'S A PROBLEM SOLVER!

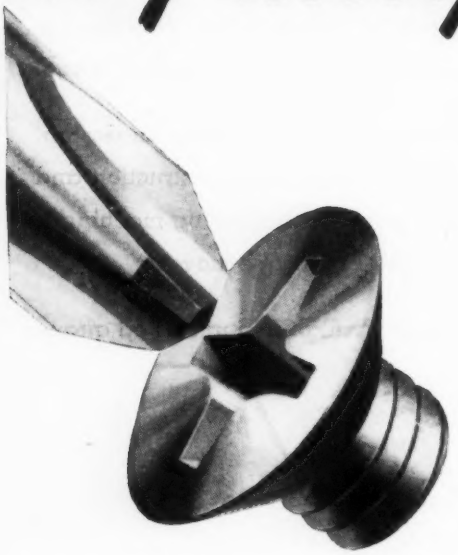
Management and workers aren't the only ones who benefit from Phillips Screws. Design Engineers find there's no easier way to plan extra fastening strength and rigidity into a modern streamlined product – and to lower costs at the same time!



IT'S A SALES BUILDER!

To salesmen, too, use of Phillips Screws pays dividends: in a stronger, smarter product . . . that has no burred screw heads to disfigure surfaces and snag clothing. Ornamentally as well as functionally, this recess is engineered to SELL your product!

It's Phillips — the engineered recess!



In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

. . . It's the exact pitch of the angles that eliminates driver skids.

. . . It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

. . . It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

PHILLIPS *Recessed Head* SCREWS

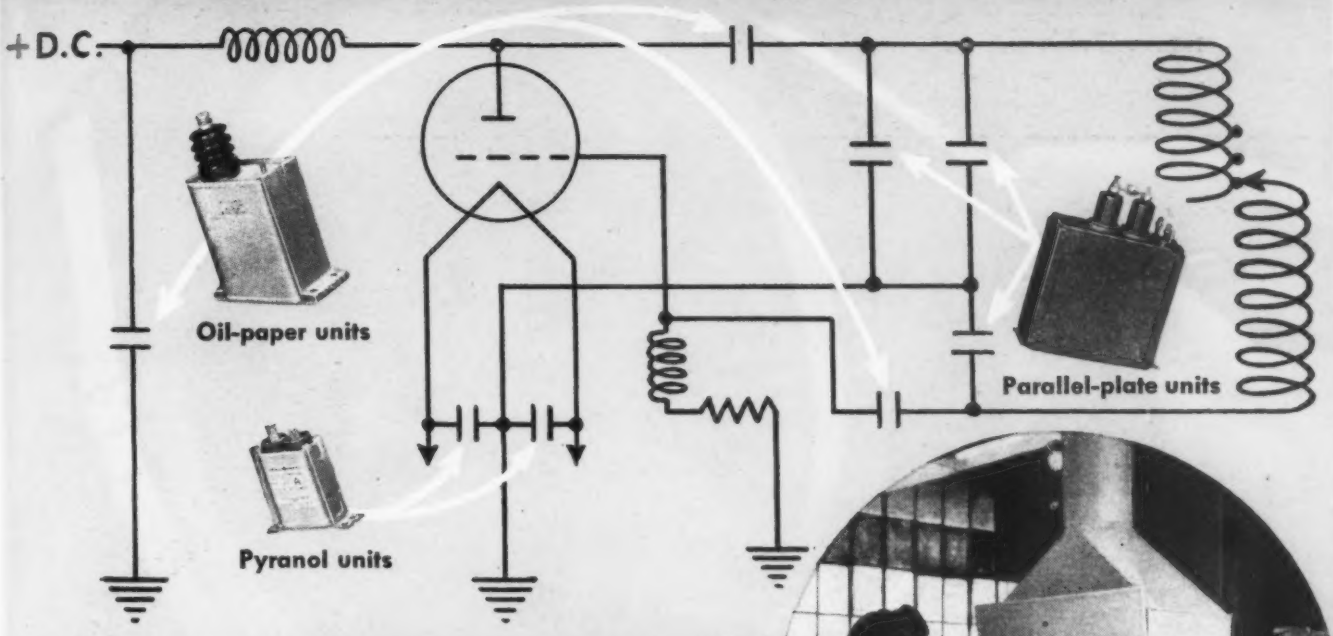
WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

24 SOURCES

American Screw Co., Providence, R. I.
Atlantic Screw Works, Hartford, Conn.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N.Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Wolverine Bolt Co., Detroit, Mich.

HOW G-E CAPACITORS are being used on new jobs



8 CAPACITORS NOW DO THE WORK OF 31 in this h-f oscillator circuit, and save space, weight, money

THE great number and wide diversity of capacitors required by today's electronic circuits make their selection an important factor in the design of the completed electronic device. Capacitors *designed for the job* can often appreciably reduce the over-all weight, size, and cost.

Take the simplified electronic-heater circuit shown above: The *original* circuit called for 31 capacitors. By selecting G-E high-frequency capacitors *designed for electronic-heater applications*, this number was reduced to eight.

Four mica capacitors were replaced with three G-E oil-paper blocking capacitors. This change alone saved more than $50.

In the resonant circuit, it originally took 25 mica units to do the job that three G-E high-frequency parallel-plate capacitors are now doing. These compact water-cooled units permitted an additional saving of more than $200, as well an appreciable reduction in the over-all dimensions of the electronic heater.

Electronic heater being used to solder on the covers of G-E capacitors. Four units are soldered simultaneously.

G-E capacitors designed for h-f oscillator circuits. Large unit: high-frequency, parallel-plate capacitor for the resonant circuit. The others: an oil-paper, high-frequency blocking capacitor, and (smallest) a Pyranol by-pass capacitor.

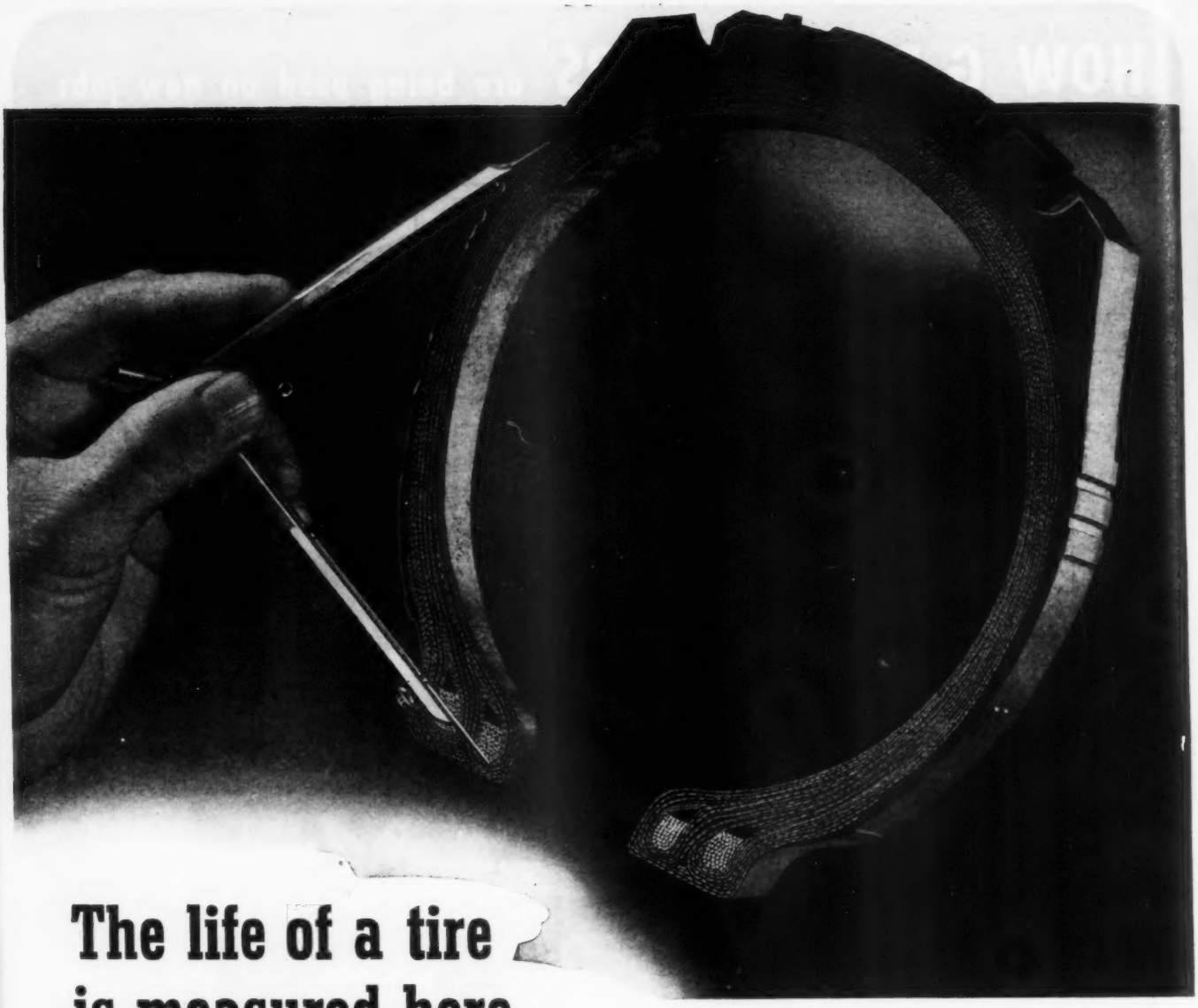
As a manufacturer of a wide variety of capacitors—including Pyranol*, oil-paper, high-frequency parallel-plate, and Lectrofilm units—G.E. is in a position to help you make savings like these in *your* electronic devices. Bulletins on our various lines are yours for the asking. See your nearest G-E representative, or write to General Electric Company, Schenectady 5, N. Y.

*Reg. U.S. Pat. Off.

Buy all the BONDS you can—*and keep all you buy*

GENERAL ELECTRIC

407-82-5700



The life of a tire is measured here

SURE, it's the tread on a tire that is actually *worn away.* But the tread can be replaced again and again. The real *life* of the tire is determined by the *carcass,* and the *bead.* That's because, no matter how fine or how frequent your recap jobs, a tire just *can't live longer* than any *one* of these *vital parts.*

The bead, especially, is an extremely *critical part* of a tire's structure. And it is only by the use of high quality steel wire, correctly applied in the bead construction, that tires have the strength and rigidity necessary for long trouble-free service. So no wonder leading tire manufacturers set such high standards of workmanship and specify National-Standard steel wire for bead making.

In close cooperation with rubber engineers, National-Standard is continually developing better and better wire for tires and scores of other wire-and-rubber applications. Since the early days of the rubber industry, improving the quality of wire for tires and developing time-saving wire applying machines, has been one of our primary concerns.

Take advantage of our skill and experience by letting us help you work out new uses for wire-and-rubber in your products.

NS
NATIONAL-STANDARD Company
NILES, MICHIGAN

Buy and Keep War Bonds and Stamps

Divisions of National-Standard Company

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TIRE WIRE, FABRICATED BRAIDS AND TAPE

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LITHOGRAPHING AND SPECIAL MACHINERY

WORCESTER WIRE WORKS
Worcester, Mass.
ROUND STEEL WIRE, SMALL SIZES

this eight-ounce detective catches each separate vibration

USUALLY, every internal vibration has a different frequency—which is its identifying trade-mark. Nab this vibration at its source and the rest is easy—the cure will suggest itself.

The new Westinghouse Vibrometer is the quickest, simplest, most economical (only $92!) instrument you can get for the job. Just hold it against the vibrating machine and turn the knob through its range to vary the length of the reed. This reed will vibrate in unison with *each separate* vibration in the machine—and you can read the frequency *directly* from the scale on the other end.

Follow this procedure for each machine, tracing the flow of power from the prime mover, and you'll be able to identify each vibration *positively*—at its source. The Vibrometer automatically breaks complex vibrations down to their component individual vibrations — no more interpolation of vibration wave forms is necessary.

All vibration frequencies between 500 and 20,000 cycles a minute register directly on the Vibrometer scale—and harmonics of a vibration will not register unless they're actually present in the machine.

Call your nearest Westinghouse dealer for a demonstration. You'll see the most versatile vibration analysis instrument available today—small enough and light enough for use *anywhere*, yet sensitive and accurate enough for every normal need. Westinghouse Electric & Mfg. Co., P. O. Box 868, Pittsburgh 30, Pa. J-08093

What the Vibrometer does—how it operates, is described in detail in this new 32-page pocket-size manual, B-3414. Write for your free copy today.

Westinghouse

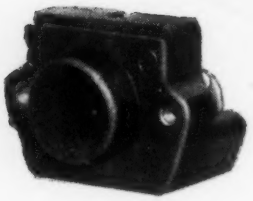
Vibration Analysis

Instruments

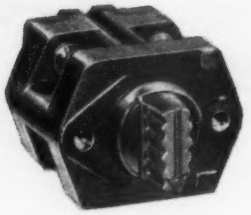
Designer's

for NEAT DESIGN at the STARTING LINE

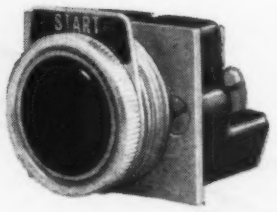
Here's help in designing panels and control stations that combine modern styling with compact, harmonious arrangement. G.E. can supply individual push-button units, selector switches, and other accessories that present an attractive "front," yet are sturdily constructed and positive in their operation, and assure long, low-maintenance service. A few of many types are illustrated below.



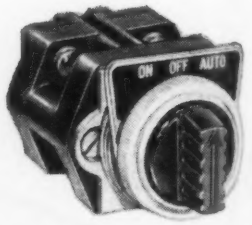
Momentary-contact button. Small in size—dependable.



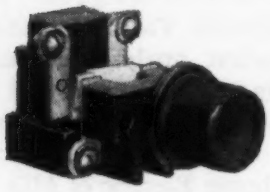
Rotary selector switch, sp, dp, 3 pos. indicating arrow.



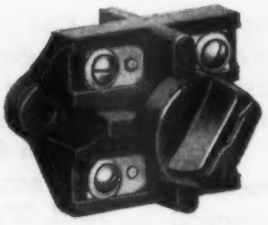
Oilproof, momentary-contact. Has graphited-leather seal.



Oilproof, rotary selector switch. Keeps out oil, dirt.

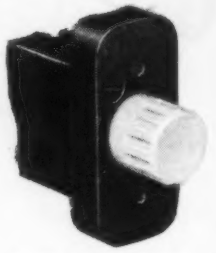


Heavy-duty, momentary-contact. Front-connected, rolling contacts.

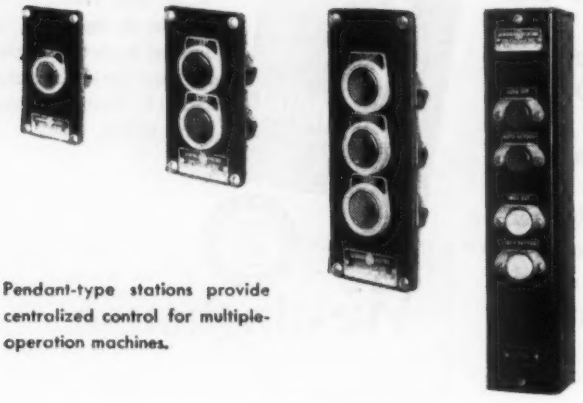


Heavy-duty selector switch. Maintains positive contact.

Oilproof indicating light. 1-hole mounting, 6 colors.



Illuminated push button. 6-volt lamp. Colored cap.



Pendant-type stations provide centralized control for multiple-operation machines.

For flush panel mounting, G-E push-button and selector-switch components can be combined in many multiple arrangements, unusually compact and dependable in service. Choice of colors and variety of nameplates.

The compact, trim-looking pendant-type stations shown at the left may be conveniently located anywhere around your machines. To provide flexibility, these stations are available carrying up to 15 push buttons, selector switches, and indicating light units, in any combination.

May we help you with your design problems? *General Electric Company, Schenectady 5, New York.*

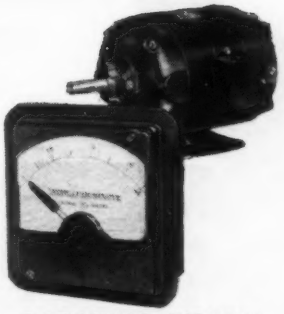
BUY WAR BONDS

GENERAL ELECTRIC

Digest

TIMELY HIGHLIGHTS ON G-E PRODUCTS

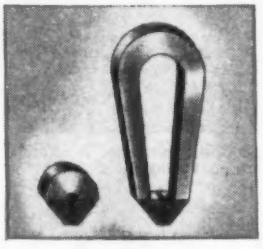
SEE your SPEED



G-E ELECTRIC TACHOMETER

G-E electric tachometers with easily readable scales, calibrated in rpm, mph, ft per min, or any variable which is a function of speed, give you a direct reading. Distance from generator to instrument is no problem.

Tachometer generators for coupling, gearing, or belting to your machines, cover a full-scale range from as low as 10 rpm up to more than 8000 rpm, depending on the type selected. Readings can be accurate to within plus or minus 1 per cent of full scale, when required. Meters can be furnished in miniature, conventional switchboard types, or in special patterns. Ask for Bulletin GEA-4324.



MIDGET MAGNETS with MIGHTY PULL

When your design calls for the use of small magnets (1/10 pound or less), you can gain important savings in space and weight by using G-E sintered-alnico magnets.

Alnico has greater stability, is more resistant to stray magnetic fields, temperature changes, and vibration than other common, permanent-magnet material. It is well suited to large-scale, close-tolerance manufacture of intricate shapes, such as used in many types of instruments, appliances, and industrial devices. Illustration shows relative sizes of equal-strength magnets of alnico (left) and tungsen. Ask for Bulletin GEA-3682.

For SMOOTH control from FAST to SLOW

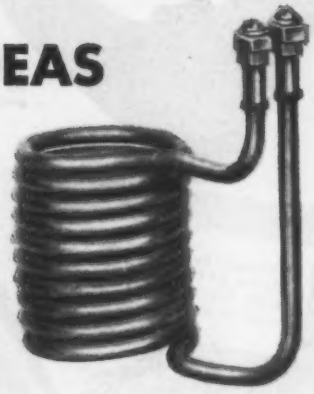
G-E THY-MO-TROL DRIVE

When only a-c is available, a simple way to make stepless, wide-range speed control an integral part of your machine, is to install a G-E Thy-mo-trol drive.

Electronic conversion to d-c gives you all the inherent advantages of a d-c motor—exceptionally rapid starting, smooth acceleration, maintenance of speed within extremely narrow limits, and delivery of full torque even at low speeds.

Starting, stopping, reversing, and control of speed are accomplished from a single station. Standard sizes from 1/8 to 20 hp. Ask for Bulletin GEA-4025.

For your "HOT" IDEAS



G-E CALROD HEATER

When your design involves the application of heat at a particular location, or for a specific operating function within a machine, you can make excellent use of one of G.E.'s outstanding contributions to the field of electric heating—seamless, flexible, Calrod heaters. Use them for contact heating of metal surfaces; for direct immersion in oil, alkaline baths, or soft metals, such as lead and solder. Cast them into iron and aluminum. Use them in industrial ovens or hot plates. They bring clean, easily controlled heat to points where products must be kept molten, where steam must be generated, or oil baths maintained at desired temperatures.

Available in standard straight, fin, or cast-in immersion types, and in various wattages. A highly popular form is the straight length Calrod, because of its bendability. G-E Calrod can be formed into practically any shape without cracking or breaking.

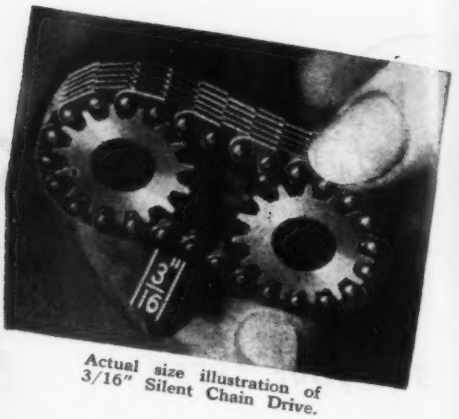
Other forms, such as G-E midget heaters, include cartridge, strip, immersion, and convection types, and heating cable. To know all the types, sizes and ratings, you will want our 56-page book "Electric Heaters and Heating Devices." Ask for GED-650B.

To GENERAL ELECTRIC COMPANY
Section A688-35, Schenectady 5, N. Y.
Please send me the following bulletin(s):
GEA-4324—Electric Tachometer .....
GEA-3682—Alnico Magnets .....
GEA-4025—Thy-mo-trol Drive .....
GED-650B—Electric Heaters .....

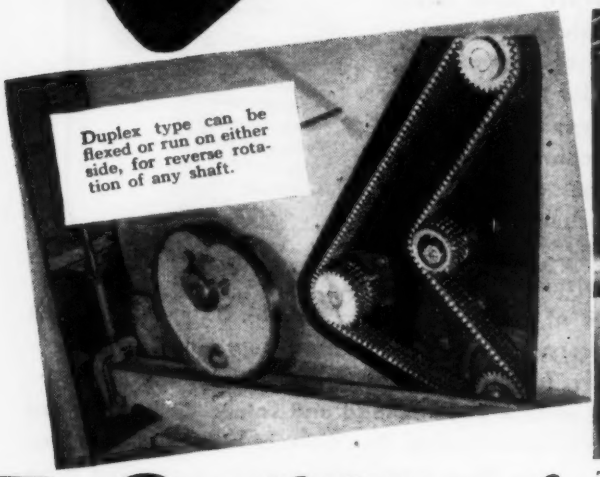
Name .....
Company .....
Street .....
City ..... State .....

85979

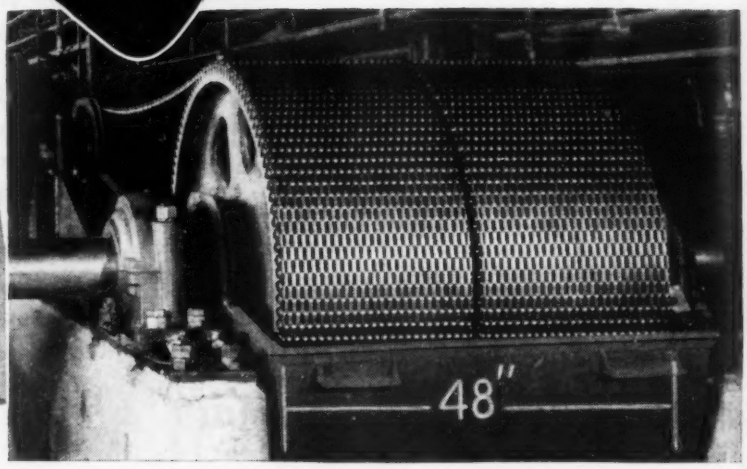
From 2½" down to 3/16" pitch, all run on extremely short centers.



Actual size illustration of 3/16" Silent Chain Drive.



Duplex type can be flexed or run on either side, for reverse rotation of any shaft.



Thought to be largest silent chain drive ever installed. 48 in. wide, 2 strands of 1½" x 24" wide chain on 7 ft. centers. Rated 1440 h.p. Chain speed 2475 f.p.m.

The Possibilities of LINK-BELT *Silverstreak* SILENT CHAIN *Challenge the Imagination!*

Silent Chain Drive Data Book No. 125 contains a wealth of engineering and application data. Send for a copy today.

Size, range, capacity, flexibility, compactness, efficiency, economy . . . A full appraisal of Silverstreak Silent Chain demands recognition of these salient qualities.

Notice full size illustrations above of largest and smallest links, and remember, in any size, Link-Belt silent chain runs slack on short centers, with full efficiency. It cannot slip, cannot waste power!

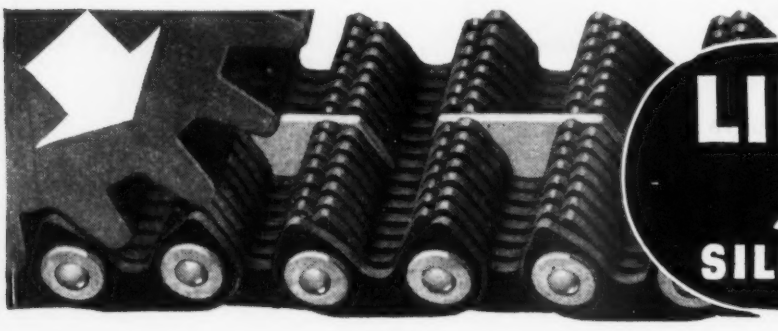
Duplex type Silverstreak Silent Chain can be wound in either direction around sprockets, giving reverse rotation wherever desired.

Low in first cost, (often lower than V belts) the cost per year of service is always lowest.

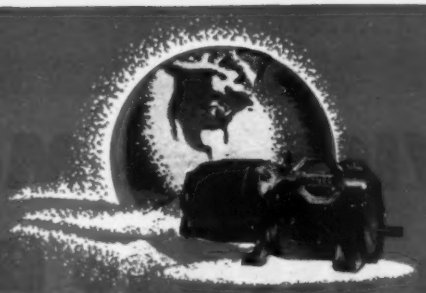
Link-Belt silent chain drives are in operation today after 10, 20, 30 years of service; with practically no attention or upkeep. They are unaffected by temperature, atmospheric conditions or age; they do not deteriorate while temporarily idle.

For production efficiency today, production economy tomorrow, depend on L-B Silverstreak silent chain.

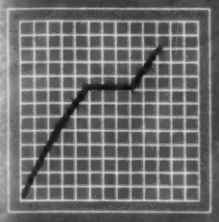
Link-Belt Company: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Toronto 8. Offices, Factory Branch Stores and Distributors in principal cities.



LINK-BELT
Silverstreak
SILENT CHAIN DRIVE



PROVEN RELIABILITY
Their durability and stamina has been proven with millions of hours of service all over the world.



INCREASE PRODUCTION
Use the right speed for each operation and increase production as much as 40%.

MASTER SPEEDRANGERS

Variable speed operation offers tremendous advantages on many applications. The Master Speedranger provides this infinitely variable speed in a compact, all-metal, mechanical variable speed unit of proven reliability.

ALL-METAL The all-metal construction of the Speedranger insures much longer trouble-free service than units in which less durable materials are used.

COMPACT DESIGN The integral construction of the Speedranger makes it very easy to use . . . only one unit to mount . . . saves space, saves time, saves money.

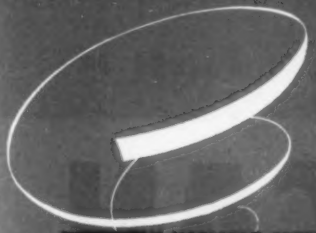
EXTREME FLEXIBILITY Speedrangers can be supplied for single phase, polyphase, or direct current operation. They can be furnished also with integrally built gear reduction units and electric brakes . . . in enclosed, splash proof, fan cooled or explosion proof construction and for a wide variety of mounting arrangements. No other variable speed unit on the market has such flexibility and compactness.

HORSEPOWER Now available in sizes 3 H.P. and smaller.

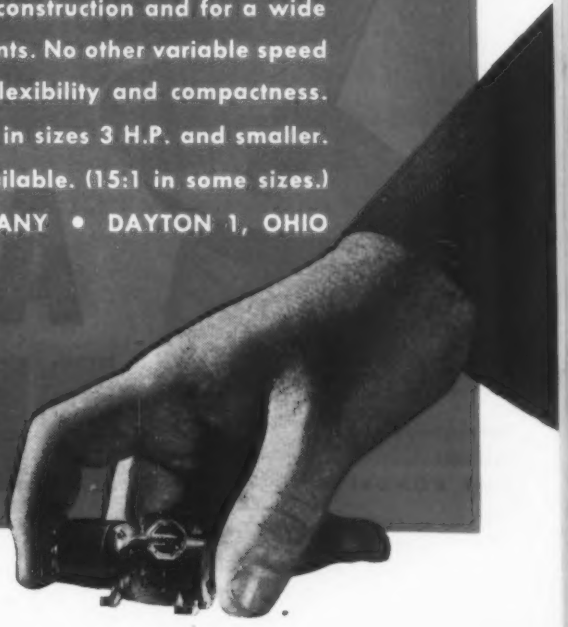
SPEED RANGES Up to 9:1 available. (15:1 in some sizes.)

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO

UNDIVIDED RESPONSIBILITY
Complete Speedranger is designed and built by one manufacturer in one plant.



INFINITELY VARIABLE SPEED
Infinite variations in speed may be secured when unit is at rest or in motion.



COMPACT
Integral, compact design saves space, saves money, improves appearance.

He's TWICE the Man He Used to Be...

when you start him driving AMERICAN PHILLIPS SCREWS

Take him off the slow, dangerous, *high-cost* drudgery of driving slotted screws. Put him on the trigger-end of a 4-winged Phillips driver and start him driving American Phillips Screws.

He'll do better work . . . because he won't make false starts, or split screw-heads, or slash up his work or himself. *And he'll increase his production as much as 50%* . . . because he won't fumble or drop the screws, or drive them crooked . . . and because he will command the super speed of power driving. Every American Phillips Screw drives straight because the screw and driver *align themselves* into a single unit that can't disengage until the screw-head is turned up tight.

THAT'S WHY AMERICAN PHILLIPS SCREWS COST LEAST TO USE UNDER ANY CONDITIONS . . . NO MATTER HOW FEW ARE USED . . . WHETHER YOUR BUSINESS IS LARGE OR SMALL.

And there are still more reasons why leaders of American industry make American Screw Company their No. 1 source for Phillips Screws. American has had long experience in Phillips production. American maintains adequate nationwide stocks . . . and every screw is American-inspected for fitness of head, thread, and point. NOW see how American Phillips screws can serve as one of *your chief weapons* to fight the costs of the future. Write.

AMERICAN SCREW COMPANY, PROVIDENCE 1, RHODE ISLAND

Chicago 11: 589 E. Illinois Street *Detroit 2:* 502 Stephenson Building

Take a Recess from Slotted-Screw Costs and Troubles ...the Tapered, Engineered Recess of:

AMERICAN PHILLIPS *Screws*

Put the Screws on the Japs . . . BUY BONDS!

HOW TO GET THE MOST OUT OF PLASTICS

IN solving a material problem, substantial benefits frequently occur which are in addition to those originally anticipated. Such was the case with the Warren Lamp Company, producers of the glass-bodied plug fuses illustrated above.

The problem which this company's research department set out to solve was to lighten the over-all weight of the plug fuse without sacrificing its quality. The reason for this attempt to lighten their product is obvious when you realize that it is the policy in the electrical manufacturing trade to prepay freight charges on all shipments up to 100 pounds.

As no other transparent material has the inertness of hard glass and as there is no satisfactory substitute for brass, the only part of the fuse that could be altered was the tip.

In the past it had been customary to use another type of mineral-filled material for this fuse tip. However, after extensive experimentation, it was found that by changing to a cellulose-filled Durez molding compound a substantial saving in weight resulted. This was because cross-sectional areas could be made much thinner due to the fact that the part molded from Durez was ten times as strong as the material previously used.

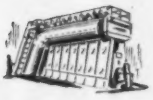
In addition to this weight-saving feature, reductions in production costs and time were achieved through a specially designed molding process, which substantially reduced the molding cycle.

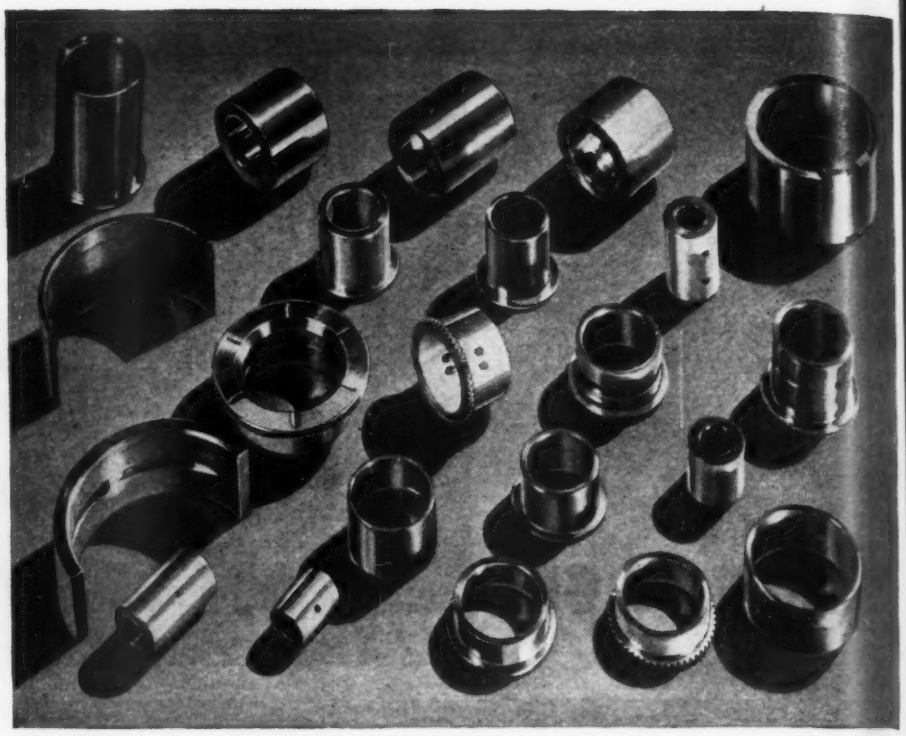
Another example of the effectiveness of co-operative effort between the design engineer custom molder and plastics producer

The versatility of the more than 300 Durez phenolic molding compounds in conjunction with the vast experience of Durez technicians make Durez' services extremely valuable to the design engineer with imaginative ideas. You can count on the complete cooperation of the Durez staff at all times in helping you and your custom molder work out any materials problem which you may have. Durez Plastics & Chemicals, Inc., 301 Walck Road, N. Tonawanda, N.Y.

DUREZ } PHENOLIC RESINS — MOLDING COMPOUNDS; INDUSTRIAL RESINS; OIL SOLUBLE RESINS

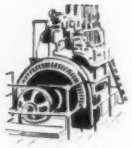
PLASTICS THAT FIT THE JOB

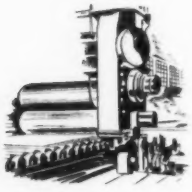




Opening

A New Chapter in the History of Bearings





IN a few short years, silver has added a complete new chapter to the history of bearings.

Applied by the Mallory electroplating process . . . used in nearly every American fighting plane . . . silver has smoothed the way to seven-mile-a-minute speeds and thousands of revolutions per minute. Here it fights friction and heat . . . withstands crushing pressures and stresses . . . permits tolerances to 2/10,000 of an inch, and surface finishes measured in millionths of an inch.

But there are many other applications to which Mallory precision bearings are ideally suited—and other materials of which they are made. The list of products tabulated below is merely suggestive of their adaptability.

The point is that as Mallory precision bearings continue to be made, the Mallory program of research goes on and on.. Improvements are being discovered continuously. New metals are being developed—some for heavy duty, others for light. Not least important, Mallory has established new and economical methods of producing precision bearings, in quantity, and final costs have been greatly reduced.

Nobody knows where the chapter will end. But wherever precision bearings must absorb unusual loads, stand up under high speeds, improve efficiency and performance—there Mallory experience will serve you well. Call on our engineers for assistance. They're ready to help you—*anytime.*

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

P R MALLORY & CO Inc

MALLORY PRECISION BEARINGS

FOR AIR COMPRESSORS • AIRCRAFT, AUTOMOTIVE AND DIESEL ENGINES • ELECTRIC GENERATORS AND MOTORS • ELEVATORS • FANS AND BLOWERS • GOVERNORS • HOME APPLIANCES • MACHINE TOOLS • PUMPS • RAILROAD EQUIPMENT • ROLLING MILLS • STATIONARY AND PORTABLE ENGINES • STOKERS • TURBINES

Yes, Men Make Motors!

NO MACHINE KNOWN can duplicate the skill of Sam Meister, left, of Allis-Chalmers Norwood Works.

Holding an acetylene torch in his right hand, a silver alloy rod in his left, Sam silver-brazes end connections of Allis-Chalmers' "Indestructible Rotor."

Round and round the connections he works — expertly flowing in molten alloy to form a joined structure that can withstand as much heat as though it were a single die-casting.

No machine can do that job — and no machine can fully test how well it is done.

There's only one test . . . wait 5, 10, 15 years and *see.*

And that's the test in which Allis-Chalmers motors have proved over the years that they're *great* motors. That's why you hear it said so often: *"You can depend on Allis-Chalmers Motors!"*

• • •

YES, HUNDREDS of Allis-Chalmers men—craftsmen like Sam Meister — know they have a big personal stake in every Allis-Chalmers motor. When they build a great motor for you, they're making a *friend* . . . and they know that's something no company and its workers can have too many of.

Next time *you* need great motors contact our district office. Or write direct to ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

A 1730

A-C WE WORK FOR VICTORY WE PLAN FOR PEACE

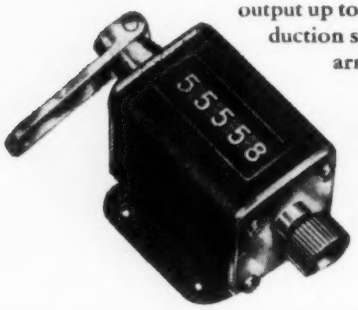
♪ *Tune in the Boston Symphony, Blue Network, Saturday at 8:30 pm, EWT.*

YOU CAN DEPEND ON ALLIS-CHALMERS MOTORS

Here's a Feature Your Customers are going to *Go For*

...more than ever before

All through the war effort, more and more machine operators and production men have been learning how much Veeder-Root *Count*rol can help them to keep machine-output up to rated capacity and meet production schedules on time. And in the armed forces, too, G.I.'s have learned to rely on Veeder-Root *Count*rol in the operation of many types of military weapons and equipment.



So in the future there will be more people than ever before who have learned the truth of the statement that "*no production machine is complete unless it can count.*" And it's a simple, inexpensive matter to design into any machine a Veeder-Root Counting device — to show whether that machine is delivering full rated capacity, so that any adjustments needed can be made immediately to keep performance or production up to schedule. There are Veeder-Root Devices for mechanical or electrical operation, to count in any terms or units desired... compactly made, with simple connections to fit into any design requirements. Find out, now, what Veeder-Root *Count*rol can add to *your* peacetime picture. Write and say when you want to see a Veeder-Root engineer.

The Counting House of Industry

VEEDER-ROOT INCORPORATED

Hartford 2, Connecticut

In Canada: Veeder-Root of Canada, Ltd., Montreal
In England: Veeder-Root Ltd. (new address on request)

...if it takes electric heat

WESTINGHOUSE CONTROLS CAN SIMPLIFY YOUR PROBLEMS

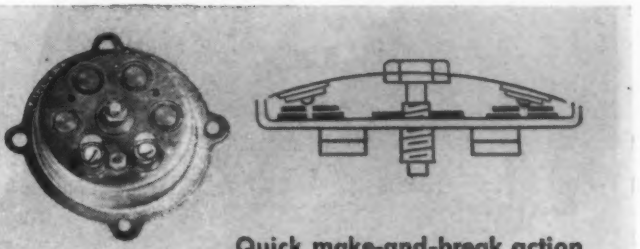
If your product uses electric heat, standard Westinghouse thermostatic controls can simplify your problems for temperatures up to 650° F. At the right are three of these units which offer special advantages for many applications.

Other standard thermostats include the Clostemp (close control for small appliances), the Guardsman (for small, low-wattage equipment), and a water-heater thermostat (high resistance to lime formations; extreme accuracy).

These thermostats are backed by more than 6,000,000 applications in Westinghouse appliances alone. The complete Westinghouse line offers the safe, accurate control needed for modern electrical appliances.

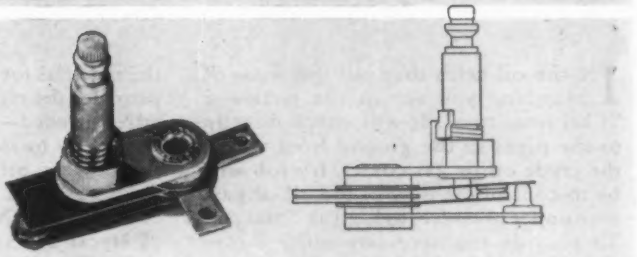
If your product involves a heat control problem, get your copy of descriptive booklet B-3344 containing complete design and installation data on Westinghouse thermostats. Ask your nearest Westinghouse office. Westinghouse Electric & Manufacturing Co., P. O. Box 868, Pittsburgh 30, Pa.

J-10272



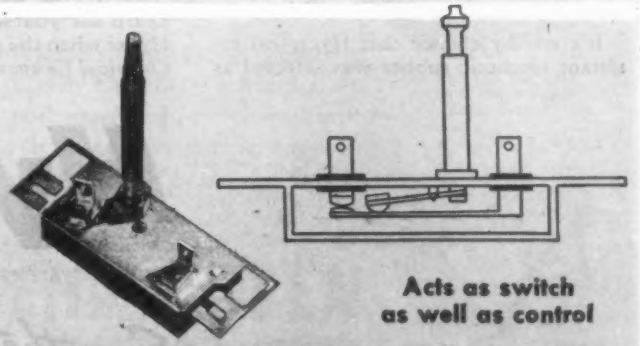
Quick make-and-break action

The Built-in Watchman Thermostat regulates with bullet-speed action on such applications as vulcanizers, glue pots, radio and aircraft equipment, and for motor and wiring overload protection. Excellent for d-c applications.



Close control for varying loads

The Uni-Therm Thermostat combines small size and easy mounting with exceptionally close control under varying loads for flatirons (dry and steam), ironing machines and platens.



Acts as switch as well as control

The Sentinel Thermostat is designed to act as a switch in "low" positions. Particularly useful in roasters, water heaters and casseroles.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

HEATING UNITS AND CONTROLS

Photo courtesy Oil Center Tool Co.

Resilient synthetic rubber sealing rings stand 15,000# test pressure

IN the oil fields they call that mass of plumbing you see in the picture a "Christmas tree". It will attach directly to the pipes in the ground from which the crude oil or gas comes. It's job will be to control the flow of the oil or gas, even under pressures as high as 7,500 psi. To provide the necessary safety factor that figure is doubled for test purposes.

Eight resilient Hycar sealing elements —the cutaway drawing shows their location—are used in this unit. They will be constantly exposed to oil or gas—in addition to terrific pressure—throughout the life of the well on which this Christmas tree is installed—perhaps a matter of years.

It's not by chance that Hycar oil resistant synthetic rubber was selected as the material for the sealing rings. Hycar provides the right combination of properties needed—oil and gas resistance, the ability to *stay* resilient, abrasion resistance to protect against the gritty fluids that will be flowing through the casing head. These and other properties of Hycar are shown in the box at the right. The list will tell why Hycar is being selected to perform in the toughest types of service throughout all industry—pump and valve packings, diaphragms, vibration dampeners and scores of other industrial applications.

Ask for parts made of Hycar. Test them in your most difficult applications. Learn for yourself that it's wise to use Hycar when the going gets tough. *Hycar Chemical Company, Akron 8, Ohio.*

Check These Superior Features of Hycar

1. **EXTREME OIL RESISTANCE**—insuring dimensional stability of parts.
2. **HIGH TEMPERATURE RESISTANCE**—up to 250° F. dry heat; up to 300° F. hot oil.
3. **ABRASION RESISTANCE**—50% greater than natural rubber.
4. **MINIMUM COLD FLOW**—even at elevated temperatures.
5. **LOW TEMPERATURE FLEXIBILITY**—down to —65° F.
6. **LIGHT WEIGHT**—15% to 25% lighter than many other synthetic rubbers.
7. **AGE RESISTANCE**—extremely resistant to checking or cracking from oxidation.
8. **HARDNESS RANGE**—compounds can be varied from extremely soft to bone hard.
9. **NON-ADHERENT TO METAL**—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)

Hycar

Reg. U. S. Pat. Off.

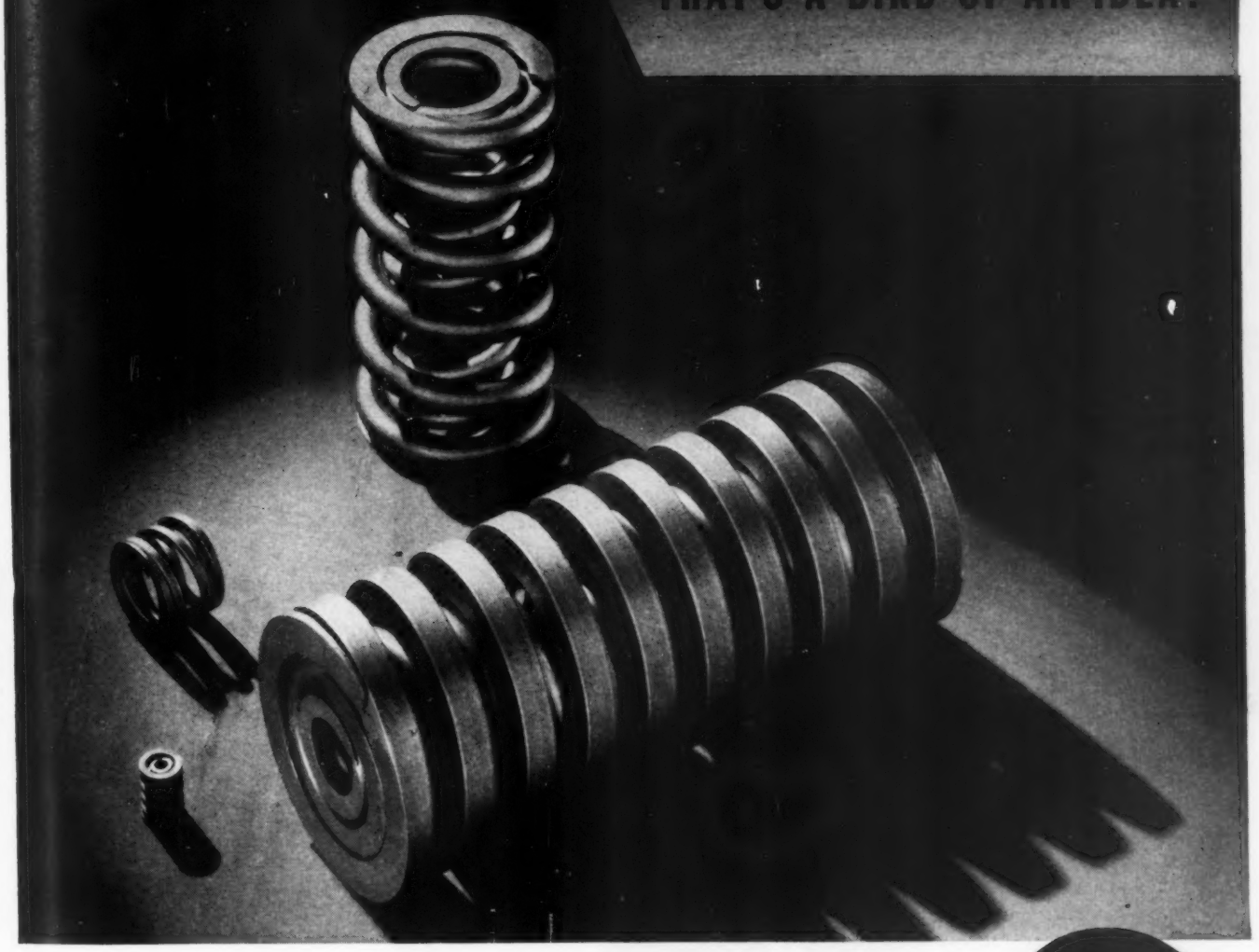
LARGEST PRIVATE PRODUCER OF BUTADIENE TYPE

Synthetic Rubbers

Free—write for your copy of the new Hycar Glossary of commonly used synthetic rubber terminology.

The Nested Spring

THAT'S A BIRD OF AN IDEA!



Send for free booklet on the importance of spring design.

● How to pack more spring into less space has always been a problem in product design. And today, when so many plans call for a reduction in product size or packing more power into a unit of the same size, the problem is even more serious. The nested spring is often the answer. It eliminates, in many cases, changing the size or design of the assembly in order to provide working space for a spring of increased capacity.

Designing nested springs requires more than just fitting one spring inside another. Whether to use round or square wire or a combination of both is involved. Extremely careful attention must be given to proper stresses and clearances. These, plus many other factors, emphasize the need for skilled spring engineering, and that's why so many product planners bring their problems to MUEHLHAUSEN SPRING CORPORATION, *(Division of Standard Steel Spring Company)*, 810 Michigan Ave., Logansport, Ind.

***To improve product performance, use* MUEHLHAUSEN Designed SPRINGS**

BUCYRUS-ERIE
10-B
Excavator

An excavator is known by the material it moves day in and day out with the minimum of attention to its moving parts.

The model 10-B ⅜ yard Excavator as engineered and built by Bucyrus-Erie uses anti-friction bearings at all vital positions.

Hyatt Roller Bearings are applied to both drum shafts because they design in advantageously and stand up under the severe operating loads.

Whatever your bearing problem may be you'll find it helpful to consult with Hyatt.

HYATT BEARINGS DIVISION · GENERAL MOTORS CORPORATION · HARRISON, N. J.

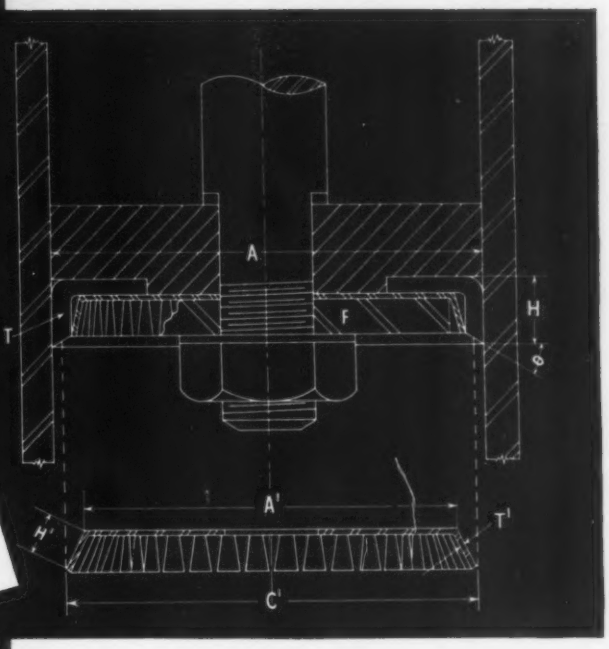
CHICAGO · DETROIT · PITTSBURGH · OAKLAND, CALIF.

GRATON & KNIGHT ENGINEERS

Present

PACKINGS POINTERS

No. 9



A = I.D. of cylinder or O.D. of cup packing
F = Follower plate
H = Height of cup packing
T = Thickness of cup packing
θ = Angle of bevel to horizontal
A′ = O.D. of expander at heel
C′ = O.D. of expander at lip in free position
H′ = Height of expander
T′ = Thickness of expander

EXPANDER FOR CUP PACKINGS

The use of an expander is good practice in any cup application — it keeps the packing in contact with the area to be sealed at all times. However in the majority of cases, the expander is not essential, and the extra cost of tooling up, fabricating and installing expanders is not warranted. The following cases do call for the use of expanders:

1. where particularly light, flexible cups are used.
2. where sudden pressure differentials occur.
3. where part of the stroke is manual and the cup is expected to suck in fluid to keep the cylinder full.

Expanders are also used in cases where the cylinder is slightly out of round or where there is a variation in diameter from one part of the cylinder to another. In some appliances, where long periods of stand-by are expected, expanders help to keep the cup in contact with the cylinder wall and provide instantaneous seal when called upon to operate.

FINGER-TYPE EXPANDER

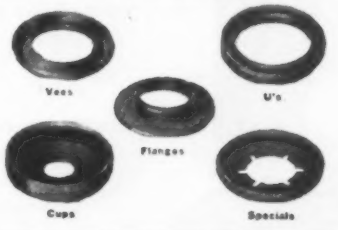
The most satisfactory type of expander is the finger-type. It is simple, efficient, easily installed, and requires only a slight change in diameter of follower plate (F). It is usually made of spring steel or phosphor bronze.

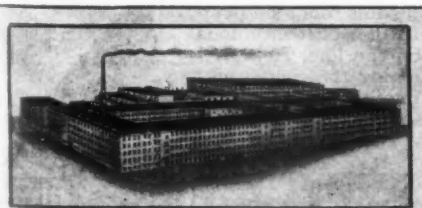
It is not possible to establish a set formula for the design of all finger-type expanders. Variations in equipment, size, pressures, materials are all factors that have a bearing on expander design. However, the following general rule is a safe starting point:

A′ = A–2T–2T′
C′ (in free position) = A–2T′
H′ = H–T
T′ = Optional (to be determined by the material used for the expander and the amount of tension required)

SPARTAN LEATHER PACKINGS

Graton & Knight's SPARTAN has highest resistance to abrasion and heat (withstands boil test), is unaffected by common pressure mediums, and will not dry out hard and brittle. It also has exceptional tear and tensile strength. When your design reaches the "packings point" —or when packings trouble occurs—call on G&K engineers.



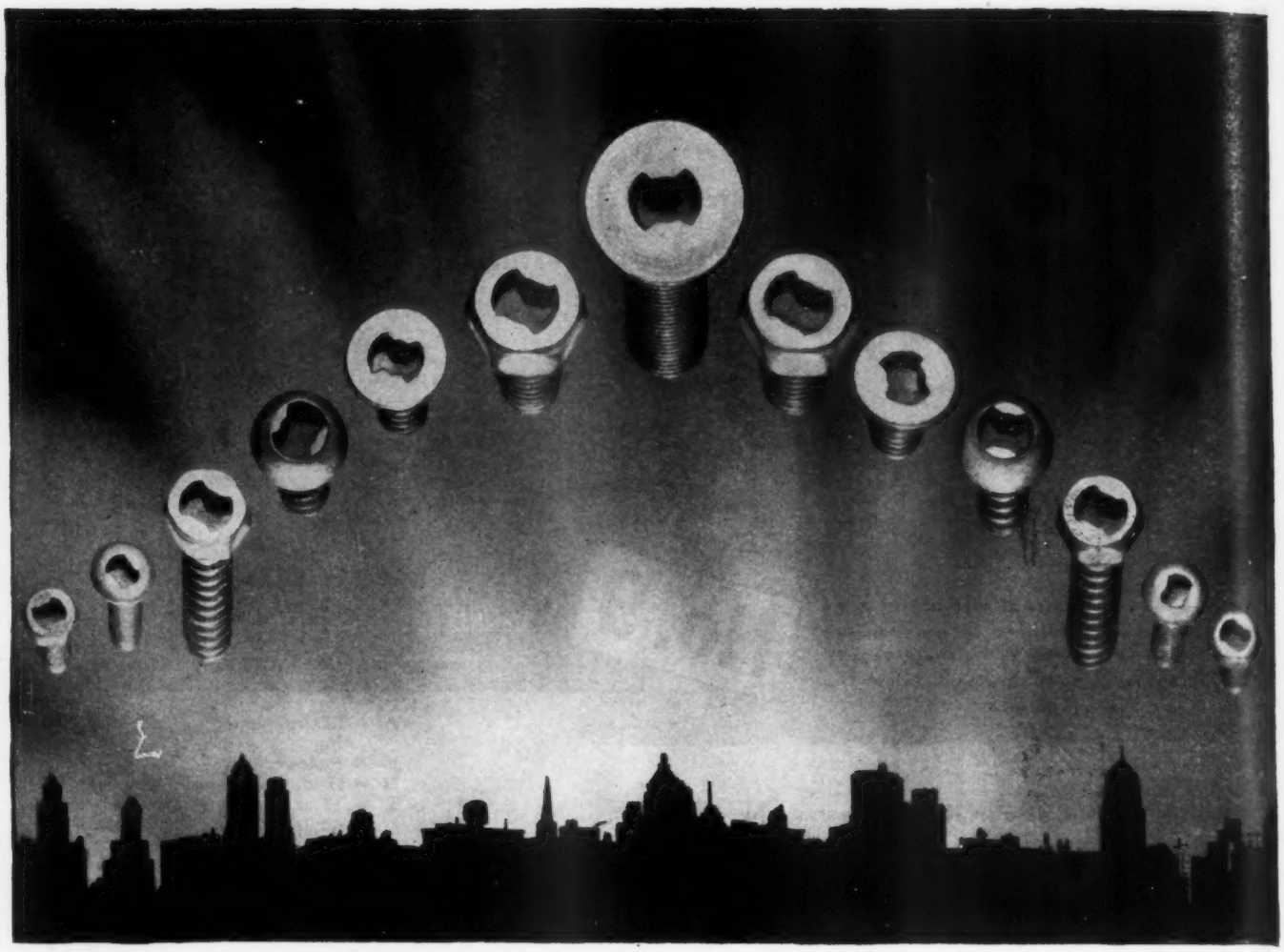


World's Largest Manufacturer of Industrial Leather Products

SPARTAN ENGINEERED PACKINGS

GRATON & KNIGHT COMPANY

321 Franklin St. GRATON AND KNIGHT Worcester 4, Mass.



New Methods in industry impose new demands on assembly lines . . . for a new measure of economy through *faster, safer, easier,* and *better* production. Wherever power driving is used, the records show that CLUTCH HEAD Screws scale down the final costs with modern features and advantages which are *not matched by any other screw on the market today.*

VISIBILITY . . . The wide Clutch recess offers a clear, definite target, inviting confidence and unwavering action by the "greenest" operator. No "breaking-in" required.

SAFETY . . . The Center Pivot on the driver makes deep dead-center entry automatic. No canting, no slippage to injure manpower or damage materials.

EFFORTLESS DRIVING . . . The straight-sided driver squarely contacts the full area of the straight-walled Clutch to eliminate end pressure as a hazard and as a fatigue factor. With CLUTCH HEAD, there is no ride-out tendency as set up by "tapered" driving.

CLUTCH HEAD LOCK-ON . . . A slight reverse turn creates a friction-hold which unites screw and driver as a unit for easy one-handed reaching to hard-to-get-at spots. No slow-down fumbling. With field service Type "A" Bits, this feature functions automatically for easy withdrawal of screws, undamaged and saved for re-use.

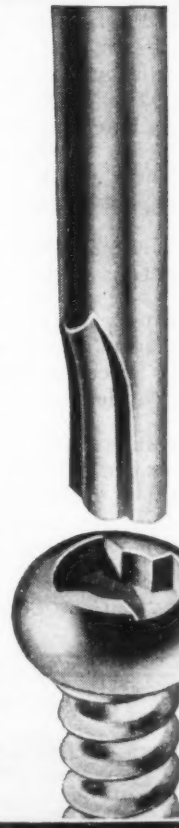
SCREWDRIVER CONTROL . . .

This is the only modern screw engineered for operation with ordinary type screw drivers or any flat blade of reasonably accurate width. Thickness of the blade is secondary because the roomy Clutch permits a wide tolerance.

CLUTCH HEAD · SCREWS ·

NEW TOOL ECONOMY . . . .

Ruggedness of structure explains why this tool stands up through a longer continuous "spell" on the line. Repeated reconditioning to original efficiency requires only a 60-second application of the end surface to a grinding wheel.

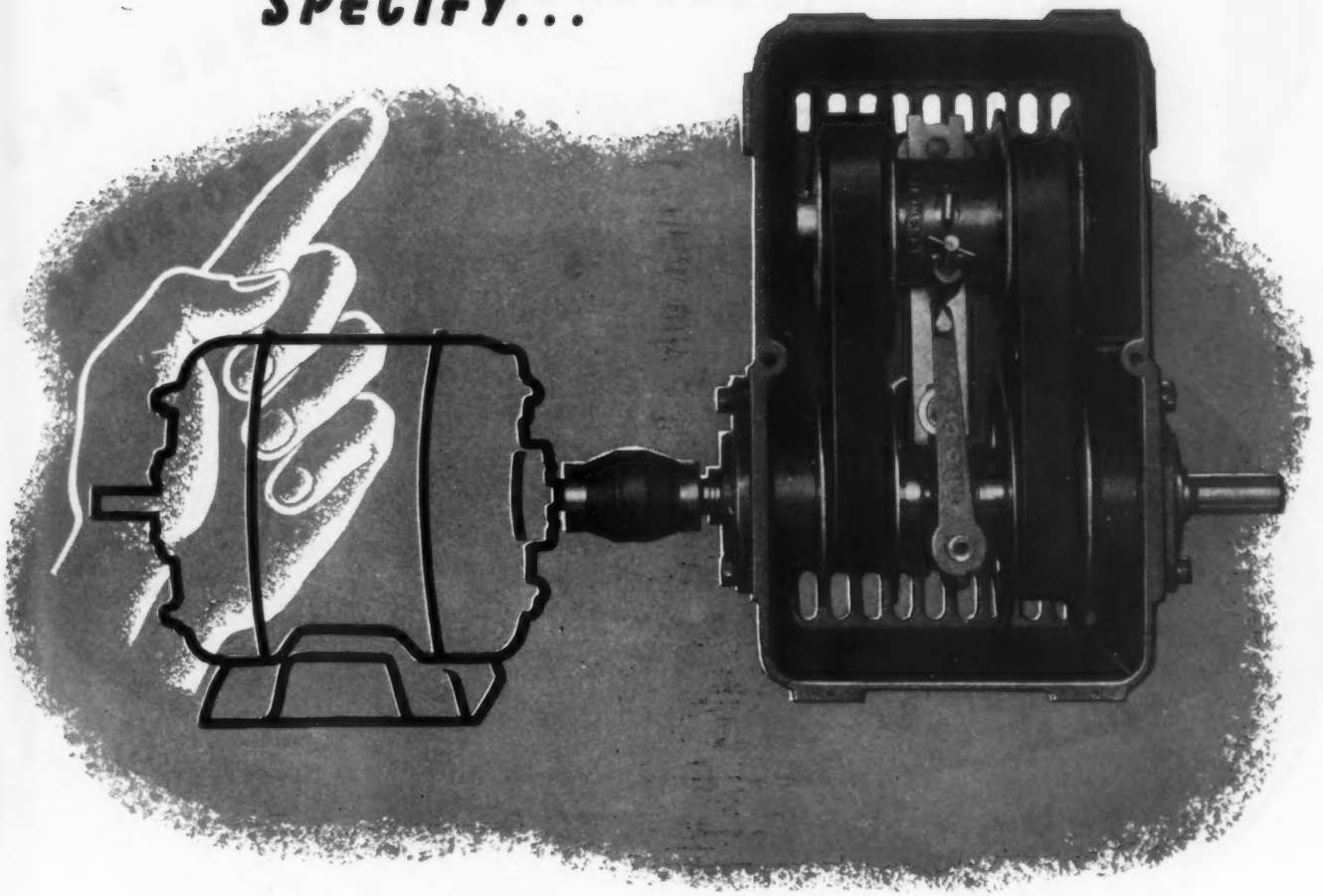


UNITED SCREW AND BOLT CORPORATION

CHICAGO 8 CLEVELAND 2 NEW YORK 7

FOR PEAK PRODUCTION
WITH PRECISION SPEED CONTROL

SPECIFY...



RPMaster
THE WORTHINGTON ALLSPEED DRIVE

RPMaster—The Worthington Allspeed Drive—V-belt, flat belt or direct connected. Simple design with minimum number of moving parts.

Model A—⅓ to ¾ H.P. 16 to 1 ratio.
Model C—1 to 3 H.P. 9 to 1 ratio also available.
Other sizes up to 25 H.P. in preparation.

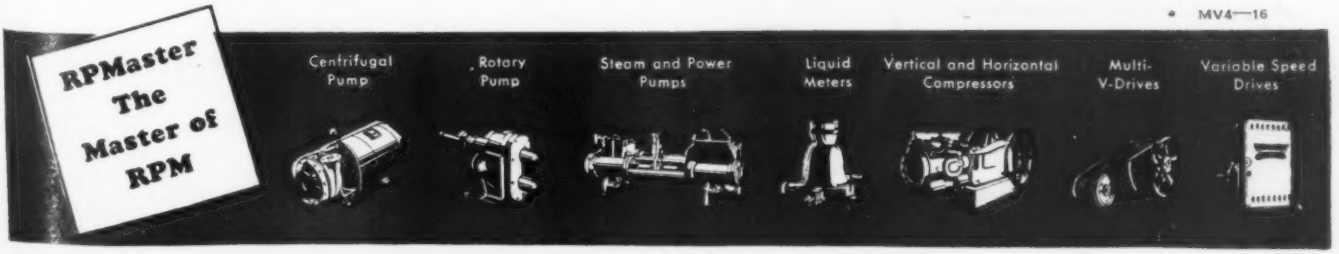
In considering RPMaster—the Worthington Allspeed Drive—remember, first, that it is a Worthington Product . . . which means that it has *acceptance* with your customers and prospects.

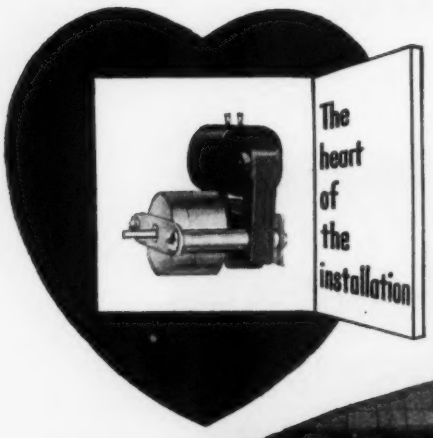
Remember next, the very specific advantages that the RPMaster offers. You get precision control, without motor stoppage, of all speeds between 215 and 3,450 RPM—a 16 to 1 ratio for the model A and from 400 to 3,600 RPM—a 9 to 1 ratio for the model C using any standard 1,800 RPM Motor. This equipment is the most compact unit in its field, and the *only* drive with automatic positive belt-tensioning. It can be installed in *any* position, and operates in either direction. *Worthington Pump and Machinery Corporation, Standard Products Division, Harrison, New Jersey.*

23 District Offices and 10 Branches Throughout the U. S.

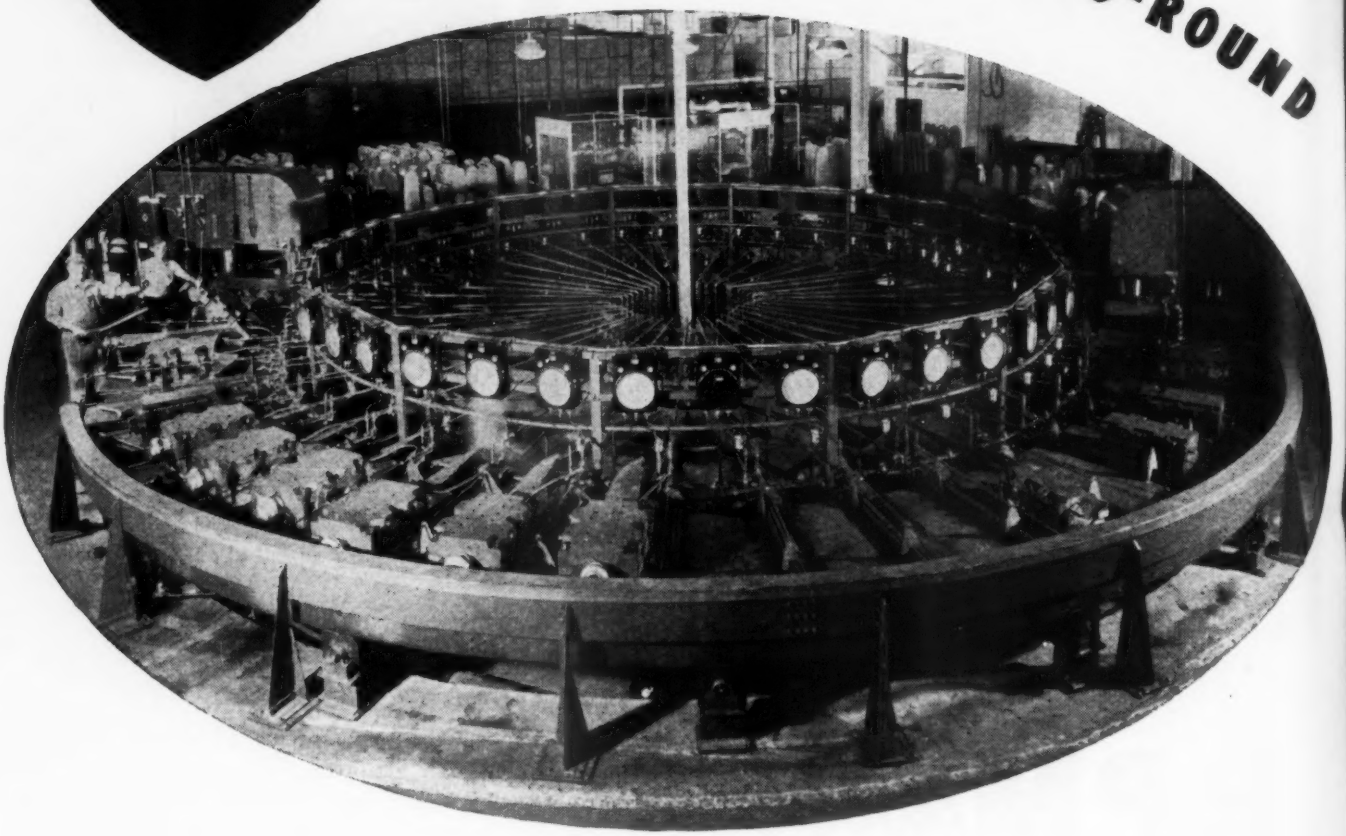
WORTH BEHIND THE NAME
WORTHINGTON

MV4—16





TELECHRON SETS THE PACE FOR THIS MERRY-GO-ROUND



This 100-ton "merry-go-round" curing press for fairings or "cuffs" on propeller blades was built in an Eastern plant to break a bottleneck in the production of these critical airplane parts.

Ebonite fairings on two sets of 21 propeller blades are cured simultaneously under the direction of the 42 instruments mounted around the center — one for each curing mold. And these instruments are driven by synchronous, self-starting Telechron motors. They control temperatures in the curing mold through cam-operated water and steam valves, and provide records of curing time and pressure for each blade being processed.

Adaptable and dependable, Telechron motors are doing all kinds of timing, controlling and recording jobs in many different fields — helping to break bottlenecks and speed victory. They are available in sizes from 12 to 250 volts for all commercial frequencies — and from 1 to 1800 rpm. Their industrial applications include:

TIMING • CONTROLLING • METERING • RECORDING
SWITCHING • CYCLING OPERATIONS • SIGNALING
FIXED PROCESS CONTROLLING • MEASURING • GAGING
REGULATION • COMMUNICATION

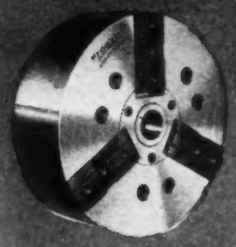
Our experience as the oldest and largest makers of synchronous, self-starting electric motors for instrumentation is freely available to you. If you'd like our help, just write Motor Advisory Service, Dept. D.

Telechron
REG. U. S. PAT. OFF.
WARREN TELECHRON COMPANY
ASHLAND MASSACHUSETTS

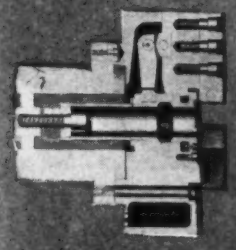
MAKERS OF TELECHRON ELECTRIC CLOCKS AND SYNCHRONOUS ELECTRIC MOTORS

Chucking time reduced to SECONDS with LOGAN Air-Operated Chucks

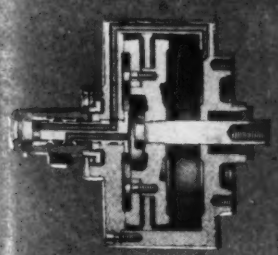
on Foster Fastermatic Automatic Turret Lathes



Model 330 Logan 3-jaw universal chuck without false jaws.



Cutaway view showing simple, efficient Logan chuck design.



Cutaway view of Model R Logan double-acting rotating cylinder.

Standard Logan air-operated chucks provide fast, accurate, positive chucking of parts —*in a matter of seconds*— on this job performed on two Foster "Fastermatic" automatic turret lathes.

The part, a hub reduction drive gear, is machined complete in two chuckings. The time and effort saved by means of the Logan equipment enable one woman operator to run both lathes and handle the entire job. Chuck jaws are quickly opened and closed by simply turning the lever of the air control valve. As a result, valuable operating and machine time is saved, production is increased, and hazards from improperly chucked workpieces are eliminated.

In addition, turning accuracy and finish are greatly improved because the unusually compact Logan chuck minimizes overhang, thus promoting rigidity and strength of the set-up. The constant, regulated pressure of the chuck jaws prevents distortion of the work.

Logan provides all of the equipment required for the complete chuck installation —standard 3-jaw universal chuck, rotating air cylinder, air control valve and accessories, all designed to operate together as a balanced chucking system. Standard chucks are also available in many other types and sizes, and special chucks can be supplied to meet unusual requirements.

For jobs where hydraulic actuation is desirable, the Logan line includes hydraulic operated chucks, hydraulic control valves and hydraulic power units.

ARMY E NAVY

Logan

Air and Hydraulic Equipment

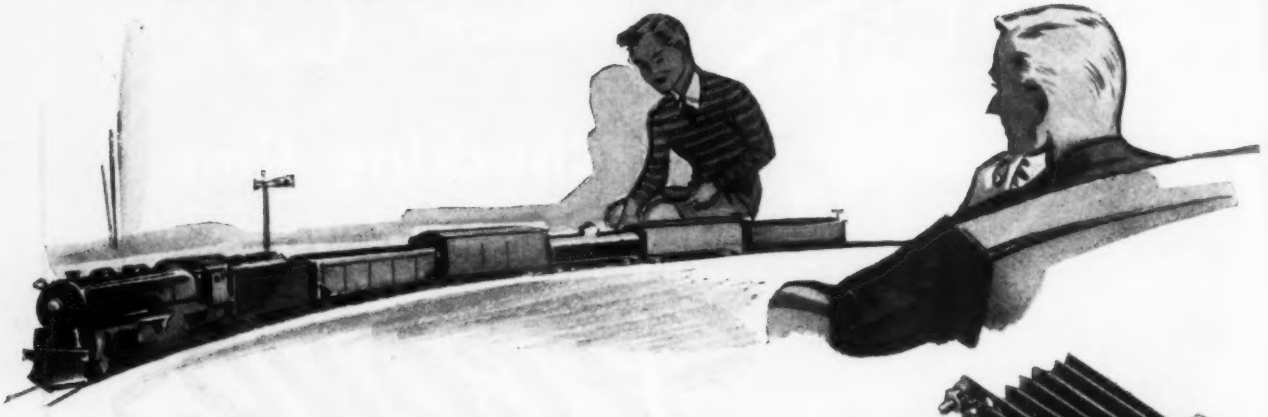
Write for new catalogs covering Logan chucks, air cylinders and accessories, hydraulic cylinders, hydraulic power units.

LOGANSPORT MACHINE CO., INC.

912 PAYSON RD.
LOGANSPORT
INDIANA

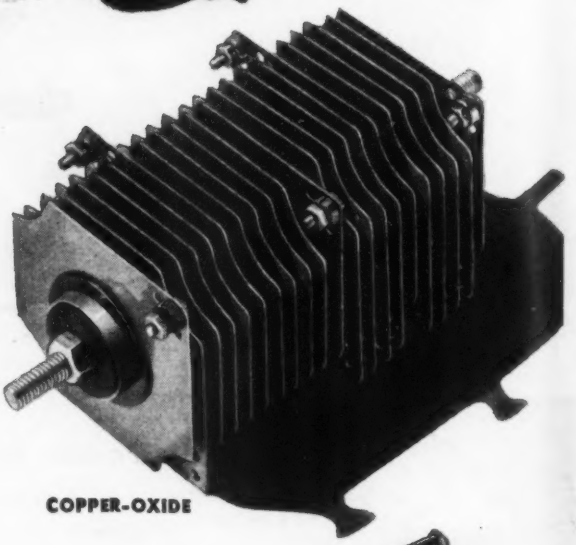
CHUCKS • CYLINDERS • VALVES • PRESSES • SURE FLOW COOLANT PUMPS

THAT TRAIN WHISTLE STARTED ME THINKING



APPLICATIONS FOR D-C RECTIFIERS ARE LIMITLESS

Oftentimes the possibilities for a product are overlooked. Think for a few minutes about rectifiers. A small copper-oxide rectifier supplies the d-c power to make a toy train whistle—in steel mills, large rectifiers deliver output of 60,000 amperes to supply power for tin plating. From the smallest to the largest application for direct current, there are copper-oxide or selenium or Tungar rectifiers to fit the need.



COPPER-OXIDE

ONLY G. E. OFFERS ALL THREE

Where other manufacturers offer one or two of these low cost, low voltage rectifiers, General Electric offers all three. Naturally, each type differs in characteristics, basic materials and construction. The most efficient rectifier for one application may be least efficient on the very next. It is in determining which type to use for each application that G.E. can help most—so look to G.E. for an impartial answer to all rectifier problems. For further information write to Section A156-42, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Connecticut.

SELENIUM

BUY WAR BONDS AND KEEP THEM

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS.

TUNGAR

GENERAL ELECTRIC

KEEP YOUR KNOWLEDGE OF CARBON AND ALLOY STEELS UP-TO-THE-MINUTE!

Write for These Two NEW Lebanon Reference Charts

WITH big production changes ahead, knowledge of materials must be up-to-the-minute. That's why Lebanon Steel Foundry now issues revised editions of its widely circulated charts on Lebanon Circle (L) Stainless, Corrosion and Heat Resistant Alloys and on Lebanon Circle (L) Carbon and Low Alloys.

First issued three years ago, these charts have been popular among steel castings users because they provide helpful information in handy form. They're file-size . . . and so designed that information is available at a glance without thumbing pages. Both charts show comparable specification designations (including wrought and cast materials), analyses, physical properties and heat treatment.

Executives, engineers and metallurgists may obtain copies of these concise, up-to-the-minute reference charts, without charge, by writing to Lebanon Steel Foundry.

LEBANON STEEL FOUNDRY **LEBANON, PA.**

ORIGINAL AMERICAN LICENSEE GEORGE FISCHER (SWISS CHAMOTTE) METHOD

Thinnest rectangular magnet wire

RIBBON FORMEX

NOW AVAILABLE IN SIZES ALMOST AS THIN AS THE HUMAN HAIR

HERE ARE SOME OF THE SIZES OF RIBBON FORMEX

THICKNESS IN MILS	WIDTH IN MILS	NOMINAL CIRCULAR-MIL AREA	NOMINAL RESISTANCE, OHMS PER 1000 FT AT 25 DEG C
4.0	100	506	20.85
5.0	100	632	16.70
5.0	85	537	19.65
5.0	125	791	13.33
5.6	112	793	13.30
6.0	125	946	11.15
6.7	100	845	12.50
7.5	85	802	13.15
8.0	100	1007	10.50
9.5	125	1496	7.07

The new and novel shapes of G-E Formex* magnet wire now being made for the war program are vitally interesting to makers of fine electronic and other electric components.

Heretofore, .015 inch was considered the low limit for thickness of rectangular magnet wire. Now, G-E Formex magnet wire is available in ribbon-rectangular shapes as thin as *four one-thousandths of an inch.*

Smooth, strong, flexible, and able to withstand high-speed winding without damage to insulation, the new ribbon-rectangular Formex offers great possibilities. On jobs where previously round wire had to be used, it will ***substantially increase*** winding space factor. It may also be used in place of larger-size, rectangular magnet wire to ***increase magnetic effect*** or ***reduce size*** of coil.

In coil winding, varnish treatment, assembly, and actual operation, this new, ribbon-rectangular magnet wire, like all other Formex shapes, offers many advantages. Note the variety of the rectangular shapes, shown at right.

For further information on the use and selection of Formex magnet wire, ask the nearest G-E office for Bulletin GEA-3911. *General Electric Company, Schenectady, N. Y.*

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

GENERAL ELECTRIC

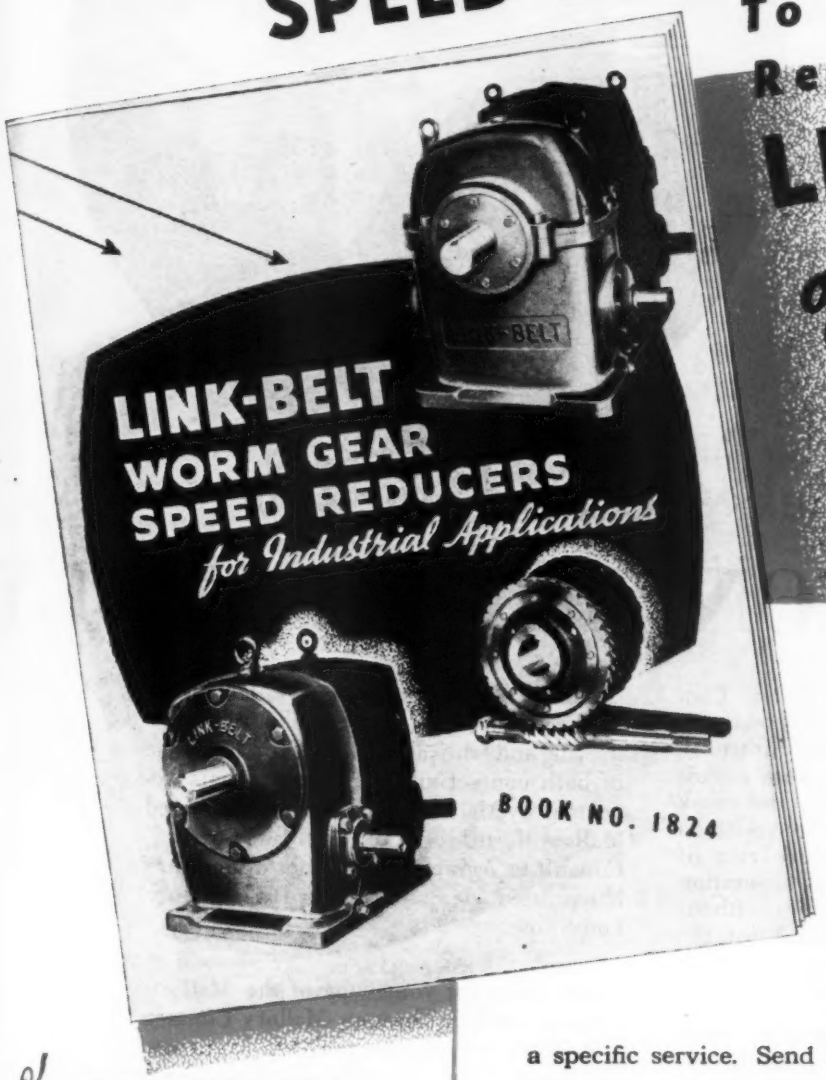
503-16-1200

TO HELP YOU SELECT THE CORRECT

WORM GEAR SPEED REDUCER

To Suit Your Exact Requirements...

LINK-BELT offers you This New Book!



Here it is! A complete data book on worm gear speed reducers for moderate and low output speeds. One hundred pages, replete with photographs, dimensioned line drawings, engineering data, horse power ratings, and tables of weights and dimensions, all aimed at helping you to make your own selection of the type and size of reducer required for a specific service. Send for your copy today.

REMEMBER!

Link-Belt Company manufactures the most complete line of Power Transmission Machinery —Chain Drives—Ball and Roller Bearings, Mounted and Unmounted—Babbitted Bearings —Couplings—Sprockets—Variable Speed Changers—Collars, Clutches—etc.

Ask for **ENGINEERING DATA BOOK NO. 1824**

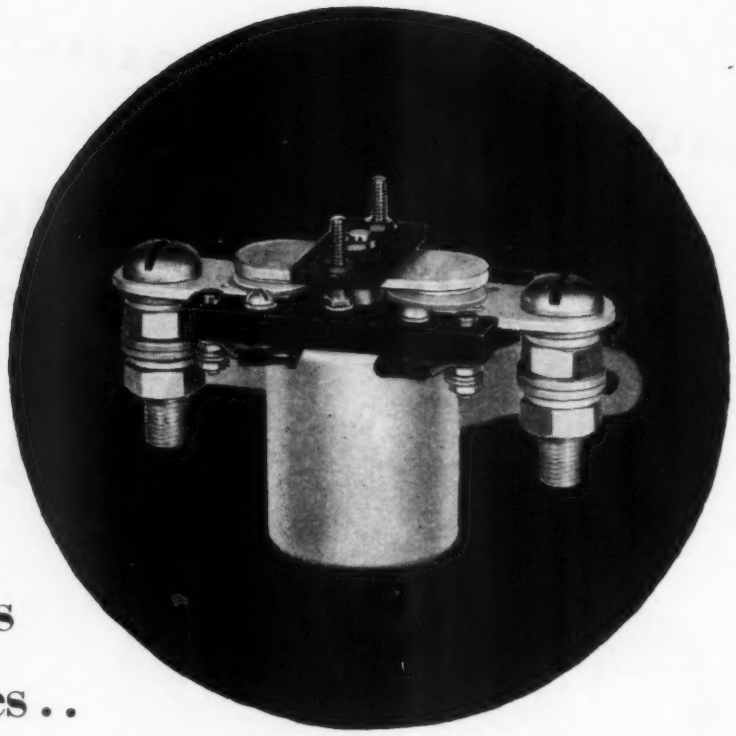
LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Toronto 8.

Offices, Factory Branch Stores and Distributors in principal cities.

9744

LINK-BELT SPEED REDUCERS



Tested 50,000 Times at 1000 Amperes.. To Exceed the Toughest "Specs" for this

MALLORY CONTACT ASSEMBLY

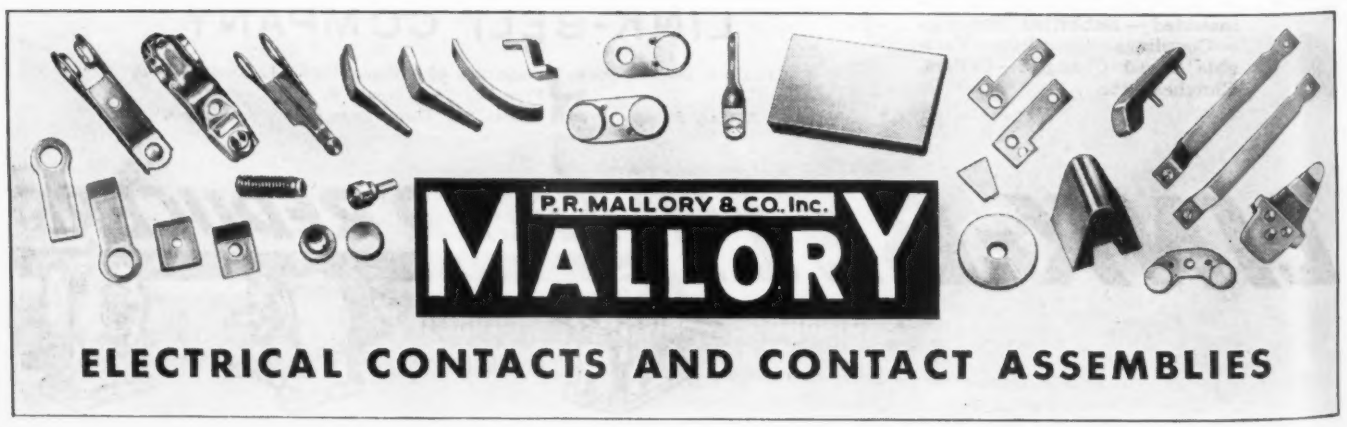
SPECIFICATIONS for the Mallory Contact Assemblies used in this relay are plenty tough—but factory tests are even more rigid. Contacts must make a circuit at 1000 amperes, 18 volts DC, and break the circuit at 250 amperes, 18 volts with an allowable contact temperature rise of 100°C. This "make-and-break" operation must be performed 50,000 times without welding of the contacts! After this test, the contacts must conduct 250 amperes with a loss of potential not to exceed 0.10 volts.

These Mallory Contact Assemblies, made of a new material, Mallory D-54, assure excellent resistance to arcing, high conductivity and good wear resistance—for efficient operation and long life.

Complete contact assemblies available from Mallory may save you considerable engineering and fabricating time. The wide range of both contact and backing materials developed by Mallory metallurgists has earned Mallory the title of "Contact Headquarters." Consult us *before* your product designs are blueprinted. It pays because of Mallory know-how.

Write today for your copy of the Mallory contact catalog. The new Mallory Contact Data Book will be sent gratis to engineers when requested on company letterhead. Available to students, libraries and schools at $2.50 per copy, postage paid.

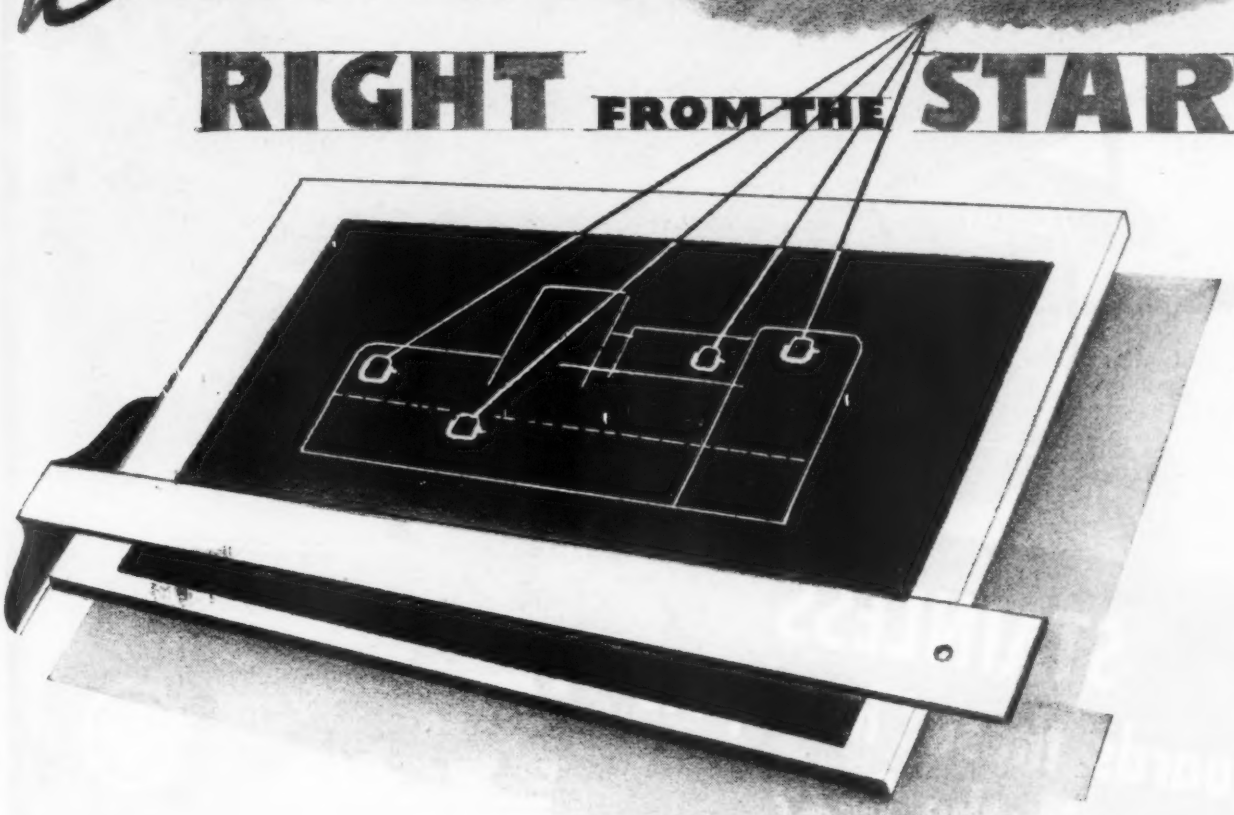
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA



Double Check

MAKE SURE THE MOTOR APPLICATION IS

RIGHT FROM THE START



ASK A WESTINGHOUSE APPLICATION ENGINEER TO HELP

Check it three times, if necessary, to make certain your product design makes use of standard motor types whenever possible. Minor changes in the appliance may permit utilizing standardized designs instead of more costly specially-engineered units.

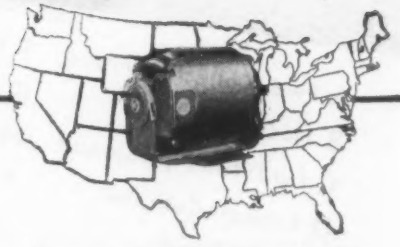
Such designs hold many advantages for both you and your customers. Costs are reduced and deliveries speeded. Required inventories are lowered. Servicing is simplified.

Let the broad experience of Westinghouse Engineers in applying fractional horsepower motors help you with your appliances while they are still on the drawing board. The time is now. Ask your Westinghouse office or write Westinghouse Electric & Manufacturing Company, P. O. Box 868, Pittsburgh 30, Pa.

J-03216

Westinghouse

SMALL MOTOR DIVISION



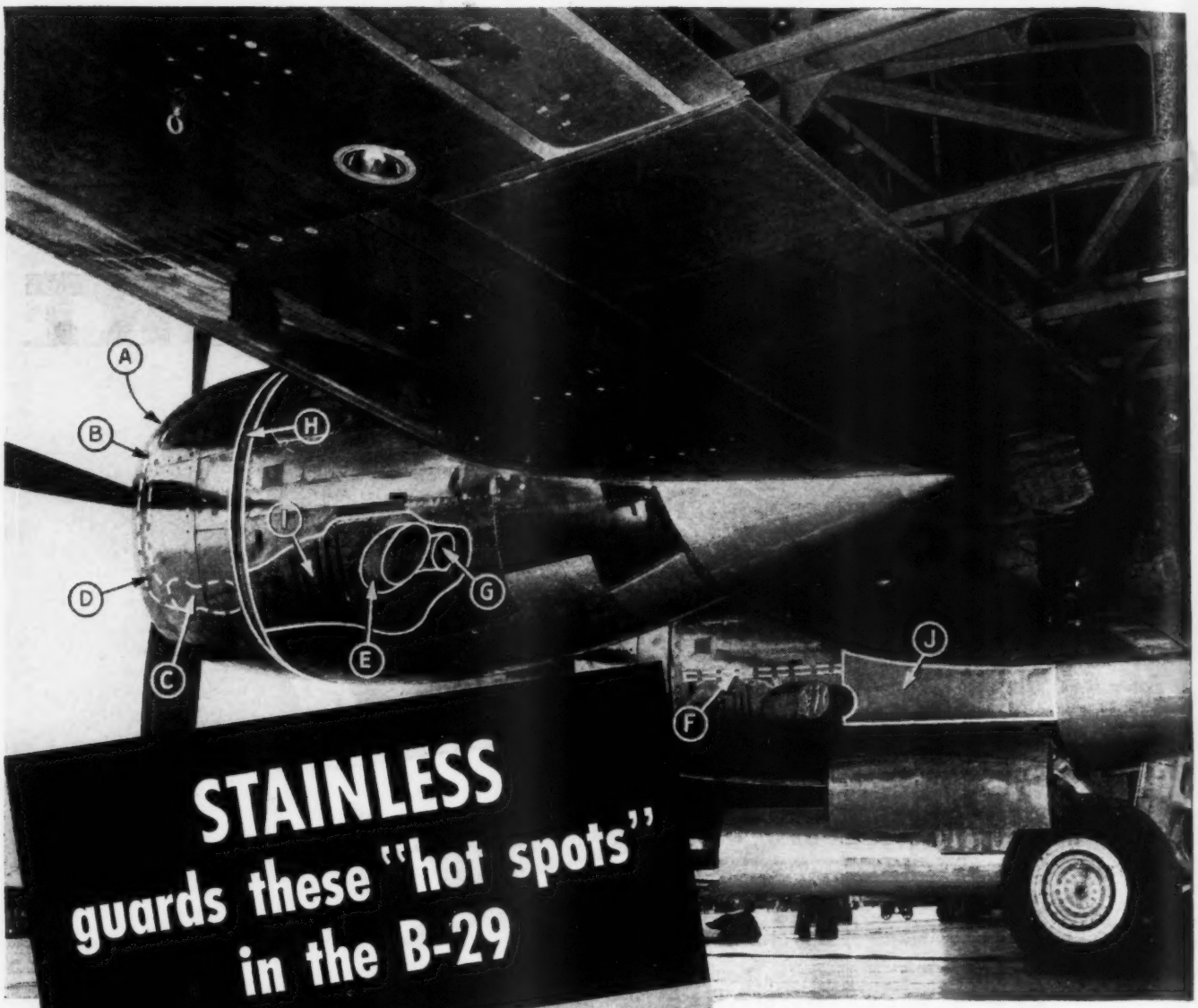
MOTOR EXCHANGE PLAN PROVIDES

REPLACEMENT SERVICE IN 24 HOURS OR LESS

ANYWHERE IN THE UNITED STATES

Westinghouse Motor Exchange points in all principal cities can service most Westinghouse small motors of standard sizes in 24 hours, or less, anywhere in the United States. This service gives the appliance user an efficient, factory-rebuilt replacement motor in exchange for his old motor at a low, flat cost. Your nearest Westinghouse office will give you full details. Ask for bulletin B-3336.

WESTINGHOUSE



STAINLESS guards these "hot spots" in the B-29

A Fwd. Collector Shroud
B Nose Ring
C Fwd. Tail Pipe Shroud
D Exhaust Collector
E Flight Hood
F Longeron
G Waste Gate Exhaust Pipe
H Inner Cowl
I Nacelle Shroud
J Slide Panel

Like all American warplanes, Boeing's super-battleship of the air is well equipped with stainless steel parts. This rustless metal is used wherever great strength and prolonged heat resistance are vital to efficiency and safety.

Some parts made of ARMCO Stainless Steels are indicated in this close-up view of the B-29. The four great housings of the Superfortresses' 2200-hp. engines embody stainless steel, selected for its strength and resistance to intense heat generated by the mighty power plants.

Other parts, like the collector systems, must "take it" too. In endless hours of combat flying, red-hot corrosive gases blast their way through exhaust collectors. And vibration puts stainless to a severe test. Yet this heat-resisting metal comes through unscathed in flight after flight.

You'll approve these other advantages of ARMCO Stainless Steels too: They form easily and can be fabricated by the fast spot-welding process. The strength-weight ratio is exceptionally high.

If you want qualities like these in your future products, consider using ARMCO Stainless. There is a grade for every requirement. For complete information just address The American Rolling Mill Company, 3561 Curtis Street, Middletown, Ohio.

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

The American Rolling Mill Company

MADE OF ★ ARMCO ★ STAINLESS STEEL

HARNESSING A BOILING LIQUID TO CHILL OR FREEZE FOOD

How Clifford Combines Metallurgical and Chemical Skill to Improve Bellows Assemblies

If sensitive control of high or low temperatures is involved in your product, you'll be interested in the way Clifford builds durable accuracy into the refrigerator control bellows assemblies shown at the left.

First, the bellows has to be strong enough to withstand the alternate strain of vapor pressure of the boiling liquid from within and resistance of switch mechanism from without. *The Hydron bellows in these assemblies have plenty of reserve strength to withstand maximum working pressure.*

Second, the right amount of the right liquid-fill must be put in the bulb so that the temperature-thrust curve will level off sharply above the working range of the refrigerator. *This is essential to enhance the life expectancy of the bellows by eliminating overpressure due to high temperature incidental to storage and shipping.*

CLIFFORD SHARES THE FACTS WITH YOU

Clifford's metallurgical and chemical know-how, some of which is summarized in charts, tables and data in our 44-page Hydron Data Book, equips us to engineer and manufacture in volume bellows and filled bellows assemblies not only for refrigerators, quick-freezers, and beverage-coolers, but also for a wide range of other products involving remote and direct control of temperatures and pressures. A get-together now with our engineering department may save you time, trouble and expense in your postwar production. Write today!

HYDRON

Fill in and mail the coupon below — today.

CLIFFORD

First with the Facts on Hydraulically-formed Bellows

HYDRON

CLIFFORD Feather Weight

Feather-weight . . . the First All-Aluminum Aircraft Oil Coolers and Coolant Radiators . . . Made with Hydron Tubing . . . Brazed by Clifford's Patented Method.

CLIFFORD MANUFACTURING COMPANY
564 E. FIRST STREET, BOSTON 27, MASS.

Please send me a free copy of your 44-page Hydron Bellows Data Book. I am interested in application of bellows or assemblies to:

- ☐ Air conditioners - unit
- ☐ Air conditioning systems
- ☐ Aircraft
- ☐ Carburetor altimeter controls
- ☐ Engine thermostats
- ☐ Gasoline valves
- ☐ High pressure steam devices
- ☐ Hot water heaters
- ☐ Instruments
  Remote and direct control of temperature and pressure
- ☐ Kilns & ovens — industrial
- ☐ Oil heating systems
- ☐ Oxygen flow indicators
- ☐ Oxygen regulators
- ☐ Process controls
- ☐ Refrigerating systems
- ☐ Refrigerator switches
- ☐ Stoves & ovens — commercial
- ☐ Stoves & ovens — domestic
- ☐ Refrigerator controls

Other applications.....

NAME.....

COMPANY.....

ADDRESS.....

WHEN THEY ARE MADE AGAIN

The Permanent Dependability of ALSIMAG

... *Proved* in Tanks, Combat Vehicles, Planes and War Ships

... *Proved* by years of service in automotive equipment

will be needed again when the automotive industry turns to peacetime production.

WHERE?

Headlight Switch Blocks
Heater Fan Rheostat Bases
Ignitor Cores for Gasoline-fired Heaters
Generator Cutout Bases
Relay Blocks
Circuit-breaker Blocks

WHY?

Because ALSIMAG is Master of power and heat. Permanently strong and rigid. Non-corrodible. Uniform—easy to assemble. Economical because of high speed production. Formulated to your specific requirements.

Investigate ALSIMAG Steatite Ceramic Insulators. Let us show you *where* and *why* ALSIMAG belongs in your equipment.

CHARACTERISTICS OF ALSIMAG INSULATORS

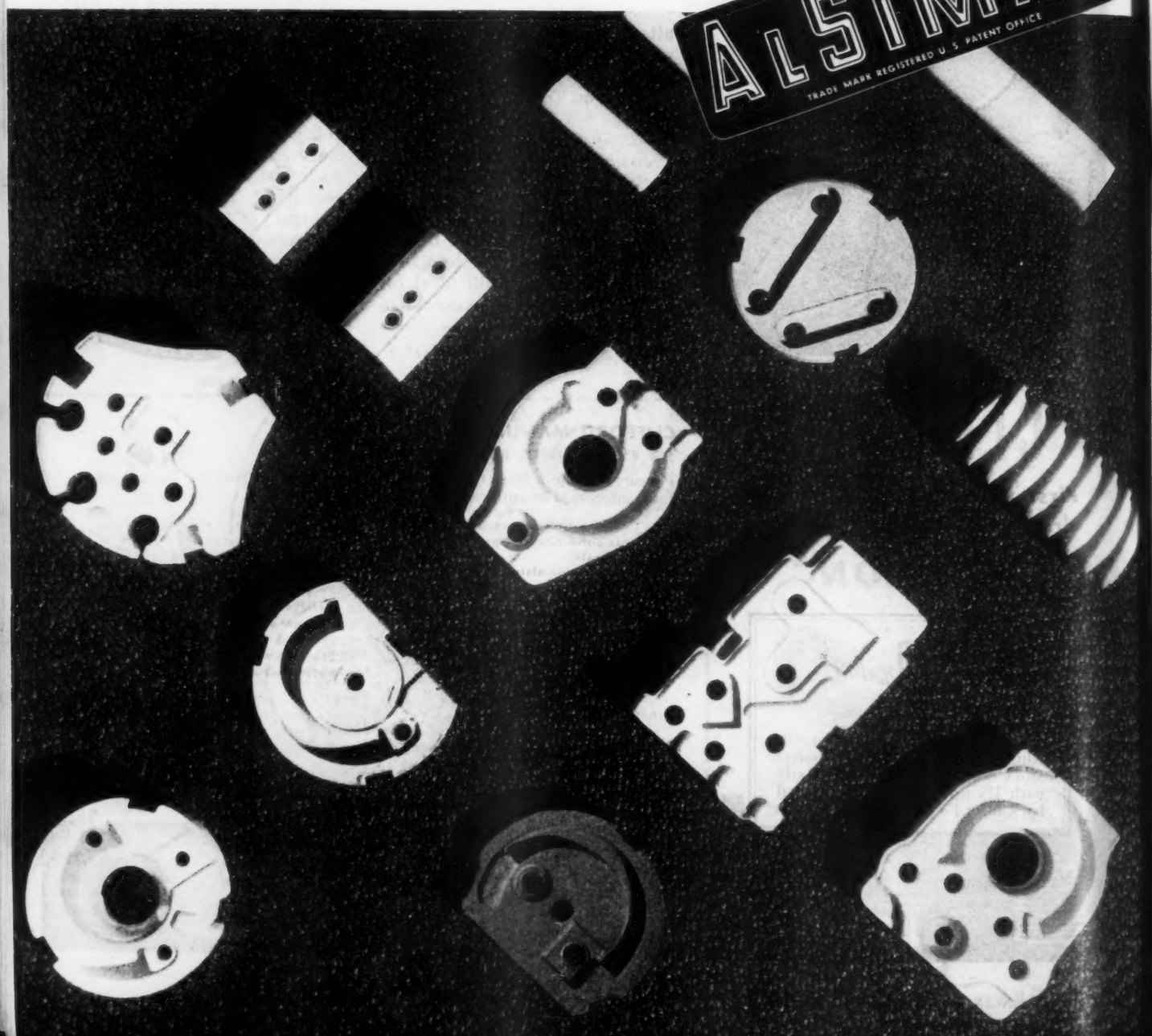
- High Mechanical Strength
- Permanent Rigidity
- Low-loss Factor
- High Dielectric Strength
- Will Not Absorb Moisture
- Chemically Inert
- Heat Resistant
- Precision Made of Raw Materials

ARMY (E) NAVY

ALCO has been awarded for the fifth time the Army-Navy "E" Award for "continued excellence in quantity and quality of essential war production."

AMERICAN LAVA CORPORATION
CHATTANOOGA 5, TENNESSEE

ALSIMAG
TRADE MARK REGISTERED U. S. PATENT OFFICE



GASKETS

- CORK
- SYNTHETIC RUBBER
- CORK-SYNTHETIC
- CORK-RUBBER
- FIBER
- FELT

FOR each gasket job, there is one right material. Finding that material calls for specialized knowledge. And this is where the Armstrong Cork Company can be of real help to you.

For, during its thirty-three years in gasket engineering, Armstrong has perfected more than fifty gasket materials—each of which solves a particular sealing problem where the temperature normally does not exceed 300° F.

Many of these materials are available not only in the form of die-cut parts but also in roll goods, ribbon, and tapes . . . in sheets and strips . . . extruded rings . . . or molded shapes.

For helpful information, see our section in Sweet's File for Product Designers—or write us for a copy of the booklet, "Gaskets, Packings, and Seals." Armstrong Cork Company, Gaskets and Packings Dept., 7101. Arch St., Lancaster, Pa.

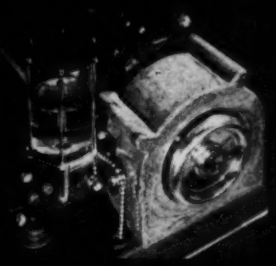
ARMSTRONG'S
GASKETS · SEALS · PACKINGS

Cork Compositions • Cork-and-Synthetic-Rubber Compositions
Synthetic Rubber Compounds • Cork-and-Rubber Compositions
Fiber Sheet Packings • Rag Felt Papers • Natural Cork

Catalin

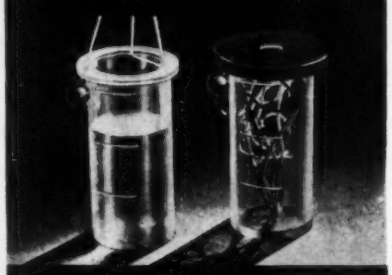
REG. U.S. PAT. OFF.

PLASTICS



Cast Resins

Catalin and Prystal thermosetting cast phenolics offer two important advantages to designers and manufacturers . . . a range and depth of gem-like colors, equalled only by minerals and semi-precious stones . . . and casting techniques which permit the use of inexpensive, quickly constructed molds with neither size nor thickness limitations. The properties of Catalin and Prystal are worth investigation.

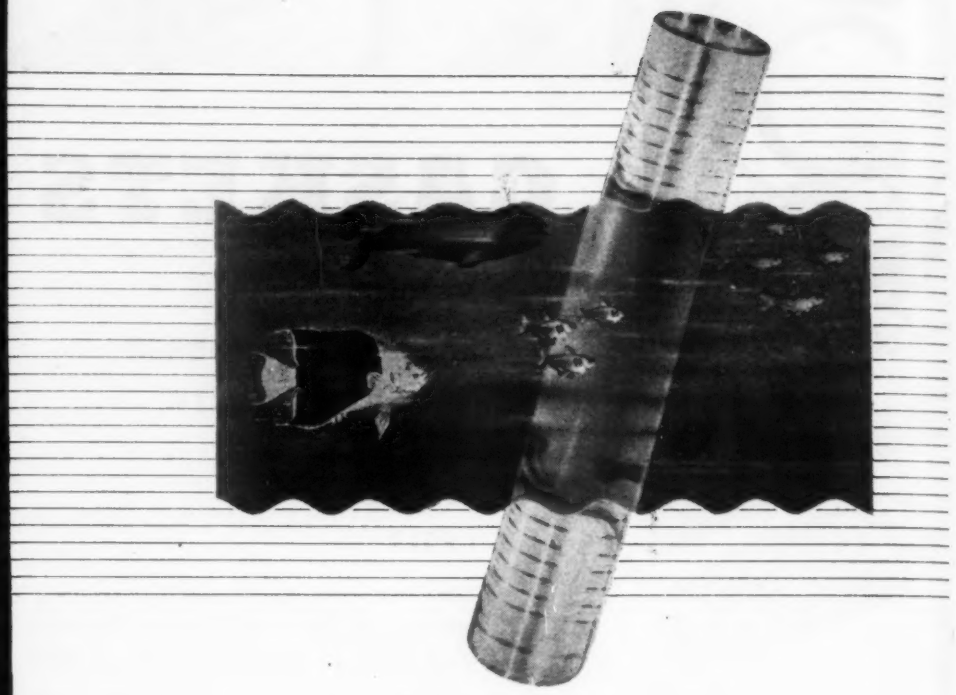


Molding Compounds

"Loalin" polystyrene thermoplastic injection molding compounds enjoy a unique position among plastics. It possesses outstanding electrical, chemical and mechanical properties. It has a "zero" water absorption and is unrivalled in dimensional stability. Loalin is the lightest weight of all the plastics and one of the least costly. It is available in a limitless range of brilliant colors.

Liquid Resins

Catabond, Catavar and Loabond identify a wide variety of liquid resin formulations employed for coating, laminating, glueing, impregnating and bonding wood, plywood, abrasives, paper, cork, brake linings, brushes, etc. Several of these formulations now make possible low-cost techniques for the fabrication of aluminum sheets. They can be economically cast at your own plant and excel as drill and saw jigs, router, shaper and hydroform blocks; checking fixtures, stretch press molds and dies.



water absorption

The degree to which a substance will absorb water is important not only in its own right but because of the intimate relationship it bears to many other physical properties.

Ratings of electrical characteristics, mechanical strengths, chemical resistance and dimensional stability may be meaningless unless the factor of water absorption is taken into consideration.

It's not enough for a plastic *material* to have certain desired qualities—those same properties must be maintained in the finished fabricated or molded *product* in actual use under field conditions and over a specified period of time.

That's why when we tell you that "Loalin", our polystyrene molding compound, has a Water-Absorption of 0.00% (24 hrs.) you know that parts or products built of this material are nowhere surpassed and rarely equalled in this vital respect. The Water-Absorption of "Catalin", our cast phenolic resin, ranges from only 0.1% ("Chemical-Resistant Resin") to 3.0%, depending on the base formula.

There's no mystery to selecting the best plastic for any specific purpose. All it requires is a thorough and *first-hand* knowledge of the physical properties and workability of each type under consideration. Our engineers and chemists have that knowledge . . . and the years of experience gained in working with designers and manufacturers in every industry.

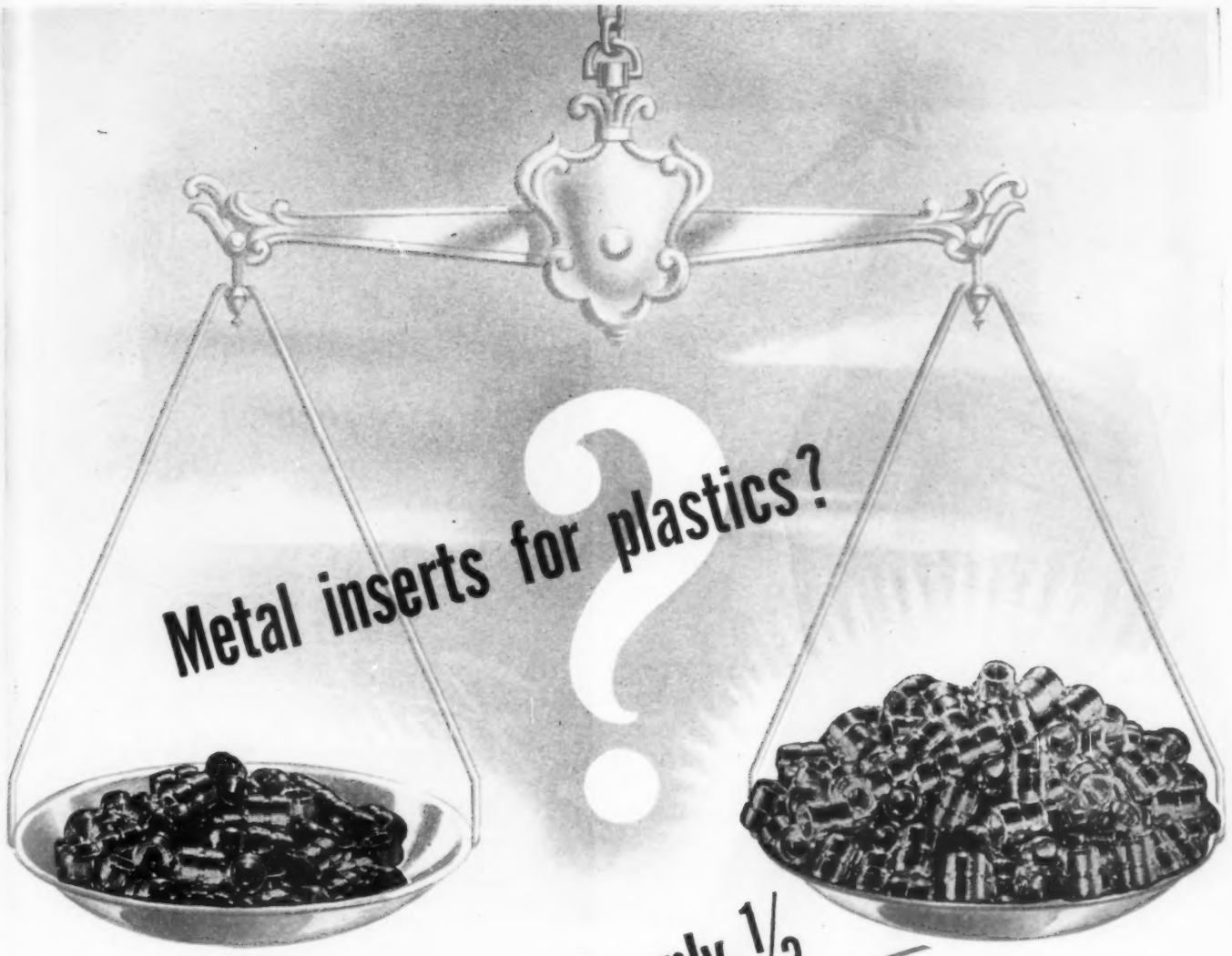
Their invaluable services are at your disposal—whether for immediate wartime needs or for foresighted peacetime planning. Your inquiry will receive prompt and expert attention.

Catalin

Cast Resins
Molding Compounds
Liquid Resins

CATALIN CORPORATION

ONE PARK AVENUE • NEW YORK 16, N. Y.



In Aluminum, they weigh only 1/3

You counted on saving weight when you decided to use a plastic. Then why use heavy metal inserts? Aluminum weighs only one-third as much, piece for piece, so it enables you to save weight there, too.

Three times as many pieces per pound often means a considerable dollar saving on these inserts.

The light color of aluminum is frequently very desirable from an appearance standpoint. Inserts in transparent plastic are less conspicuous when they're made of aluminum. Metal surfaces to be exposed can be given many attractive finishes, including colors, adding greatly to the appearance of the parts.

Alcoa will gladly quote on your aluminum inserts, or on the Alcoa Aluminum stock for fabricating them in your own plant. ALUMINUM COMPANY OF AMERICA, 2193 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN **ALUMINUM**

ALCOA ALUMINUM

New

New

MODEL JA

50,000 R.P.M.

$29.75 in U.S.A.

NOTE:—Higher speeds at higher prices are available if supporting engineering data are submitted. Higher speeds are not recommended unless properly supervised.

Weight 12 ounces; Length 6¾ inches; Chuck Size ⅛ inch.
Wheel Guard Removed for Better Illustration

KIPP
Featherweight
AIR GRINDER

The Model JA is new in design both inside and outside. It has utilized fewer parts, and they are made of Magnesium and Aluminum for extreme featherweight lightness. The [illegible] steel shaft diameter is unusually large [illegible] and ensures smooth and true operation. [illegible] still longer wheel life and better grinding. The speed, as before, is governed at 50,000 R.P.M. and there are selected ball bearings front and rear. The JA Featherweight is a distinct improvement over all models previously produced by Madison-Kipp, the originators of really high speed grinders.

The same low price, $29.75 in U.S.A., remains. It is a post-war design for which materials have been released early. The pre-announcement output was geared to expected demand. Deliveries will be made out of stock as long as possible.

by

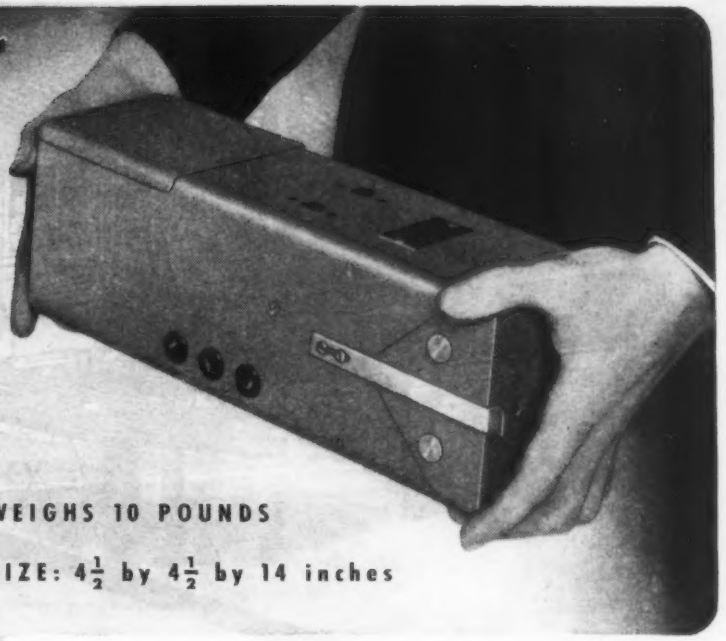
MADISON-KIPP

MADISON-KIPP CORPORATION, 206 Waubesa St., Madison 4, Wis., U. S. A.

Sole Agent in England: Wm. Coulthard & Co., Ltd., Carlisle

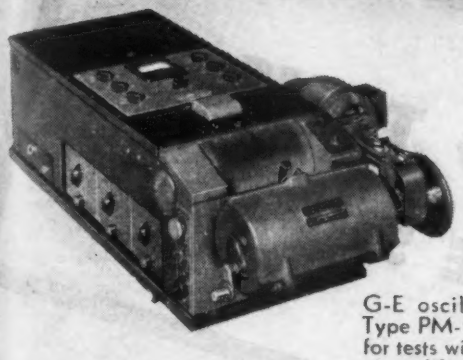
Announcing

A MINIATURE OSCILLOGRAPH



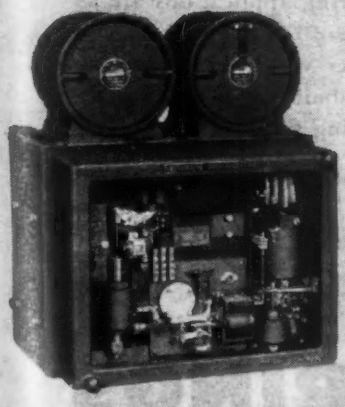
WEIGHS 10 POUNDS

SIZE: 4½ by 4½ by 14 inches



G-E oscillograph, Type PM-10, set up for tests with magazine film holder, driving head, and a-c motor unit

Portable oscillograph, Type PM-12, for general use where only two elements are required



Automatic oscillograph, Type PM-13. Starts recording one-quarter cycle after disturbance occurs

THIS 6-ELEMENT OSCILLOGRAPH was developed for use where light weight and small size are essential. It's easily portable, to obtain "on the spot" photographic records of the characteristics or the performance of many machines and devices. Records simultaneous variations of six rapidly changing phenomena. Type PM-17; net price, $850 up. Write today for leaflet GEA-4331.

IF SMALL SIZE IS NOT ESSENTIAL, HERE ARE OTHER G-E OSCILLOGRAPHS

TYPE PM-10—Records 6 to 12 phenomena simultaneously. A large, multi-element, general-purpose oscillograph for a wide field of application. Includes simultaneous viewing with recording. Net price, $3160 up.

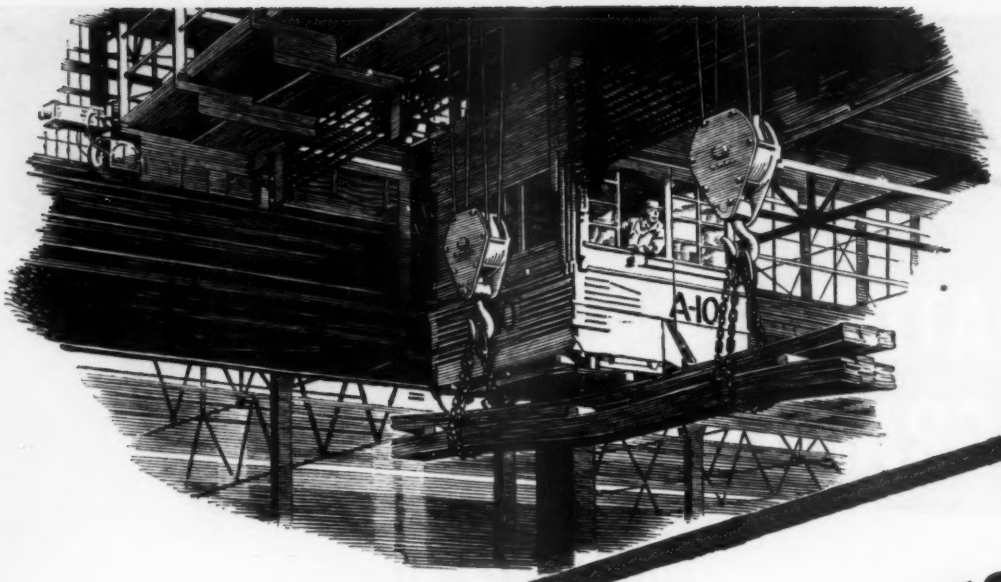
TYPE PM-12—Anyone can operate it. For work in the field, in the laboratory, or in the classroom. For either visual indications or taking oscillograms of current and voltage waves. Originally developed for school use, industry has found this 2-element portable especially valuable for observing or recording welding current. Net price, $665.

TYPE PM-13—Entirely automatic. Can take as many as 100 oscillograms of transients and surges without attention. Particularly useful for determining the sequence of relay and breaker operation and the effect on system stability. Net price, $2125.

Our nearest office will be glad to help you select the right oscillograph for your specific requirements. *General Electric Company, Schenectady 5, N. Y.*

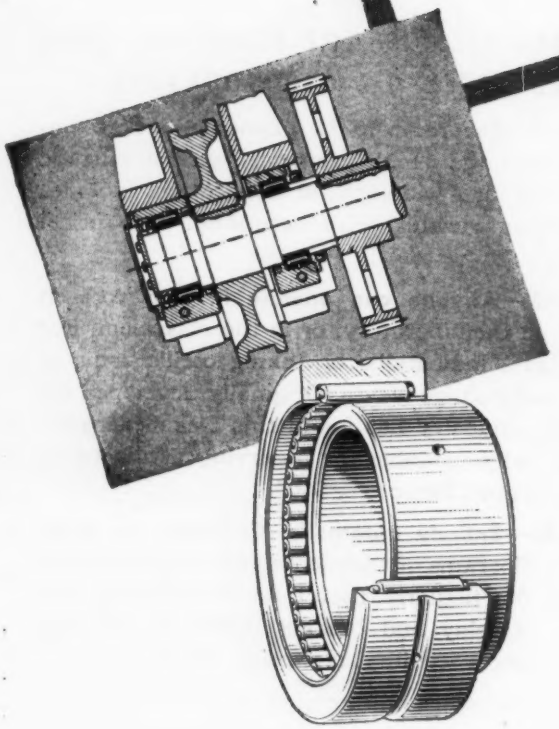
BUY WAR BONDS AND KEEP THEM

GENERAL ELECTRIC



Drawing from photograph furnished by Carnegie-Illinois Steel Corporation

PUTTING TONS ON THE SPOT



Whether it's a lifting job that calls for the maneuverability and operating ease of a lift truck, or a multi-ton lift that demands the strength of a giant traveling crane—*putting tons on the spot* is done by effortless, finger-tip control, when loads travel on anti-friction Torrington Bearings.

In the application illustrated, the high load capacity and compact design of the Torrington Type NCS Heavy-Duty Needle Bearings make them ideal for installation in the crane's axle housings.

Out of the ordinary bearing applications are an important part of the service of Torrington's Bantam Bearings Division. Whether you need counsel on standard or large, custom-built anti-friction bearings, consult our engineering staff.

THE TORRINGTON COMPANY · BANTAM BEARINGS DIVISION
SOUTH BEND 21, INDIANA

TORRINGTON BEARINGS

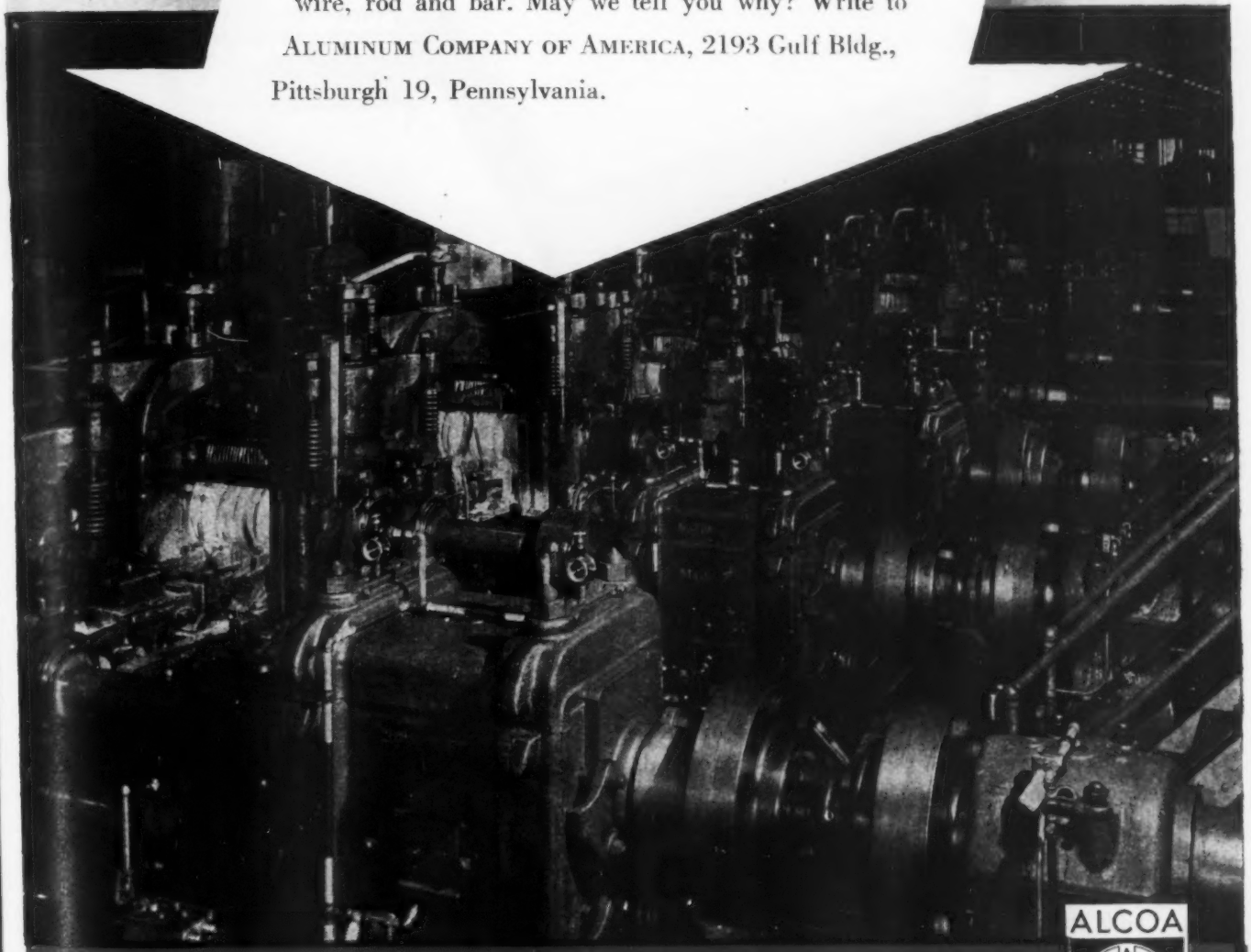
STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE · BALL

This rolling mill is evidence of Alcoa's faith in the future for Aluminum Wire, Rod and Bar

Started as a prewar project, this rolling mill at Alcoa's Massena, New York, plant was rushed to completion to make it available for war production. Aluminum alloy rod and bar stock rolled here has been an important contributor to the war effort.

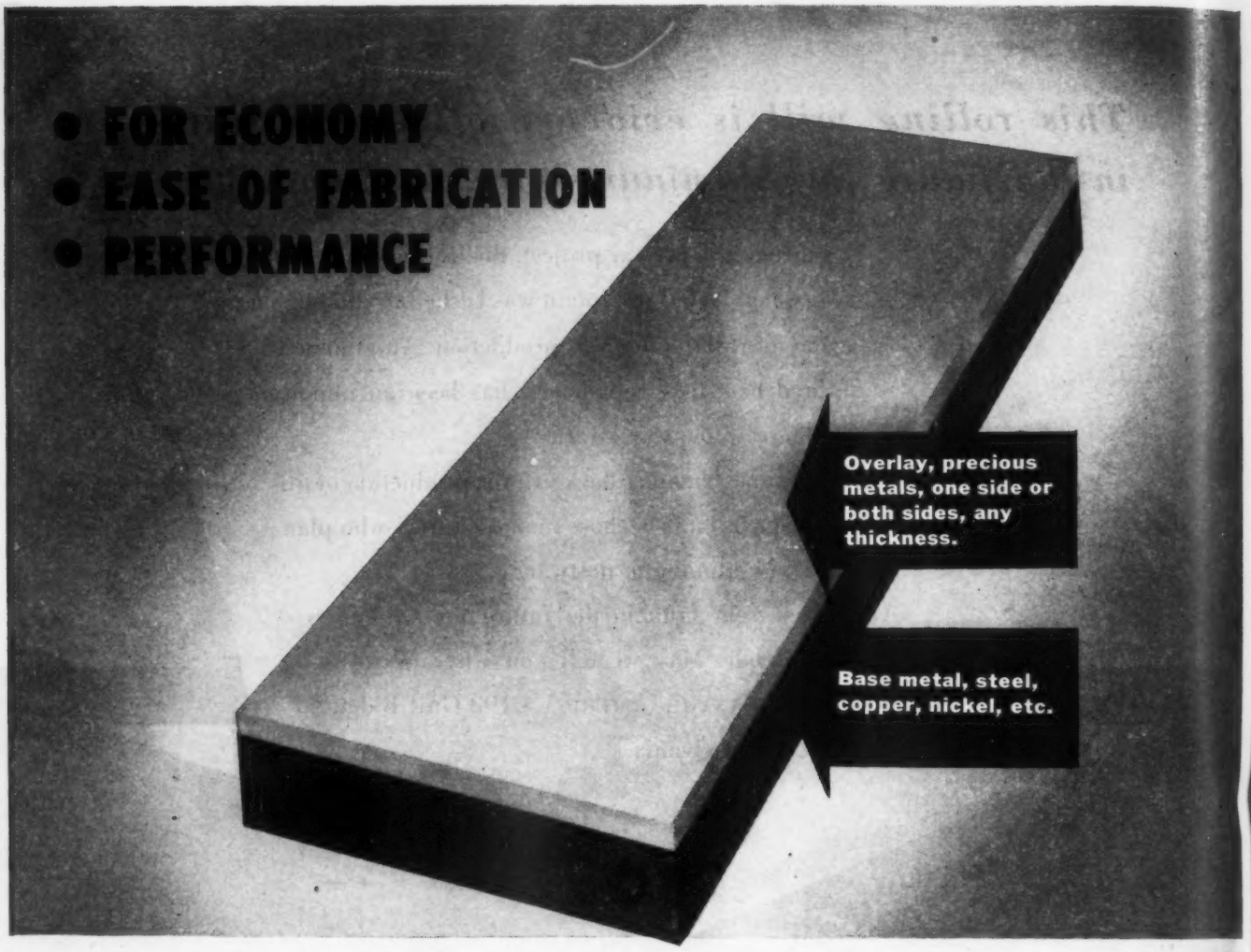
As wartime demands slack off, the production of this mill will be available to those manufacturers who plan big things with aluminum postwar.

Alcoa has great faith in the future for aluminum wire, rod and bar. May we tell you why? Write to ALUMINUM COMPANY OF AMERICA, 2193 Gulf Bldg., Pittsburgh 19, Pennsylvania.



ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM


• FOR ECONOMY
• EASE OF FABRICATION
• PERFORMANCE
Overlay, precious metals, one side or both sides, any thickness.
Base metal, steel, copper, nickel, etc.

INVESTIGATE *General Plate Laminated Metals*

For your Peace Products

No matter what your contemplated peacetime products . . . from peanut radar tubes to giant turbines, . . . General Plate Laminated Metals can offer you many worthwhile advantages from economy to better performance.

Made by permanently bonding precious metals such as silver, gold, platinum to inexpensive base metals, they are more economical because they give precious metal performance at a fraction of solid precious metal cost. The laminating process makes the precious metal harder assuring long life, while the base metal adds strength and workability.

Many base to base metal combinations which provide performance characteristics not found in solid base metals are also available.

Now, while your products are still in the design stages, is the time to investigate General Plate Laminated Metals. They are available in rawstock, inlaid or wholly covered or as fabricated assemblies. Write specifying your problems, and our engineers will make recommendations.

GENERAL PLATE DIVISION

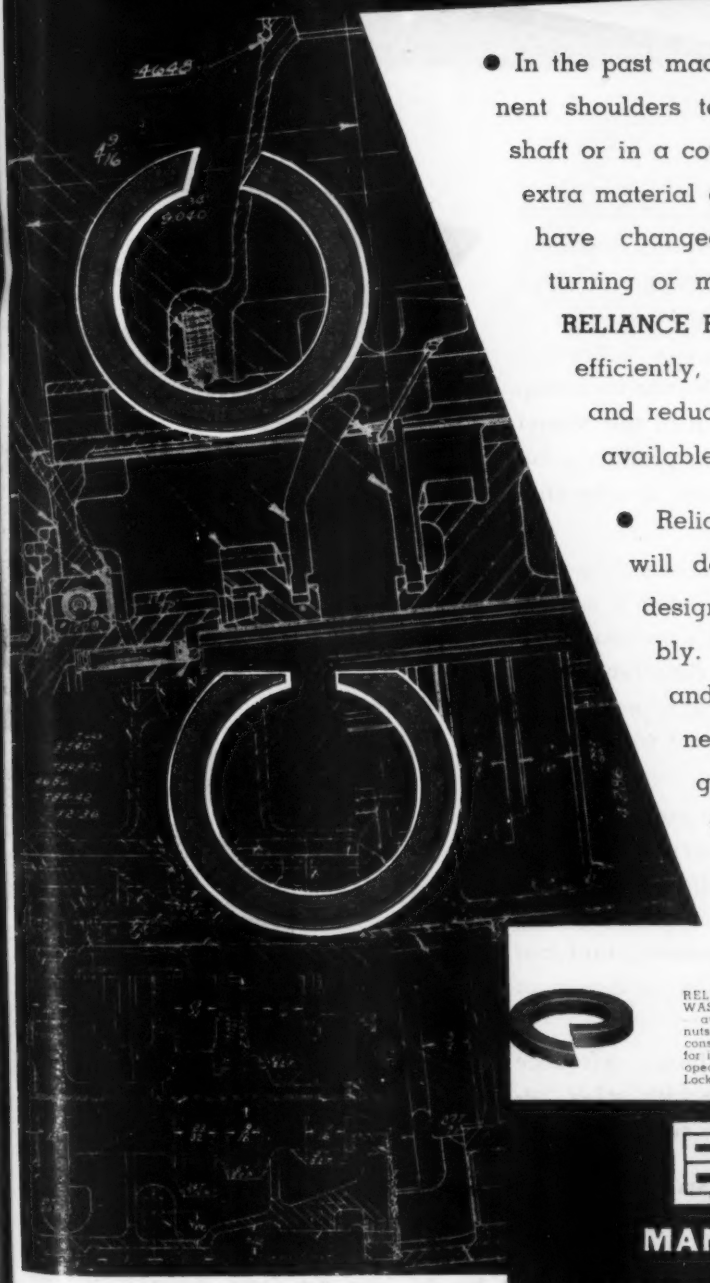
OF METALS & CONTROLS CORPORATION

Metals and Controls Corporation Divisions manufacture the following products: Laminated & Solid Precious Metals, Electrical Contacts, Rolled Plated Precious Metals to Base Metals in all forms — Truflex Thermostat Metals.

ATTLEBORO, MASSACHUSETTS

50 Church St., New York, N. Y.; 205 W. Wacker Drive, Chicago, Ill.; 481 E. Main St., Canterbury, Ohio; 2635 Page Drive, Altadena, California; Grant Bldg., Pittsburgh, Pa.

What Happens If You Design
No Such Thing?



- In the past machine and product designers specified permanent shoulders to hold various parts of an assembly on a shaft or in a counterbore. To make these shoulders required extra material and operations which increased costs. Times have changed — designers now specify through-boring, turning or milling of grooves and the installation of a **RELIANCE RING** to hold these assembled parts in place efficiently, thus saving critical metal, machining time and reducing cost. In the past **NO SUCH THING** was available.

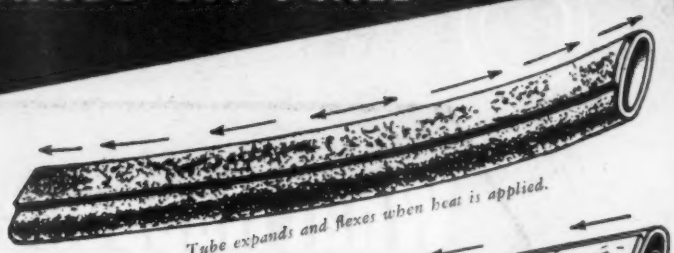
- Reliance Service and Engineering Departments will do their best to help you get the properly designed **RELIANCE RING** for your particular assembly. Send us the diameter of the shaft or housing and the approximate thrust load, and our engineers will recommend the proper size ring and groove diameter. The advantage is yours, now there is **SUCH A THING.** Write on your company letter-head for ring folder #43.

RELIANCE SPRING LOCK WASHERS for every purpose — automatically keep bolts, nuts, screws tight and under constant tension, compensating for inevitable wear and developed looseness. Write for Spring Lock Washer Folder #142.

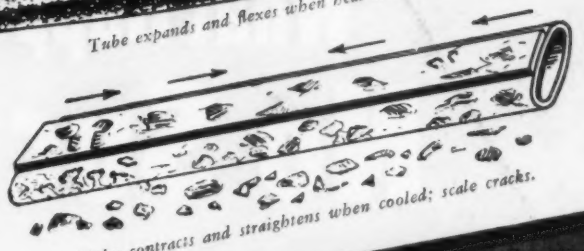
EATON SPRINGTITES — the all-in-one unit — cuts production costs by increasing production efficiency. A correctly engineered lock washer preassembled on screw or bolt for every fastening problem. Write for Folder #101.

EATON
MANUFACTURING COMPANY
RELIANCE DIVISION
DEPT. E, MASSILLON, OHIO

They wanted
A "THERMOSTAT" TO SHRUG OFF SCALE



Tube expands and flexes when heat is applied.



Tube contracts and straightens when cooled; scale cracks.

How Heat Transfer Products' Engineers applied the old bi-metal principle to a new use inside a marine evaporator —and developed self-cleaning tubes.

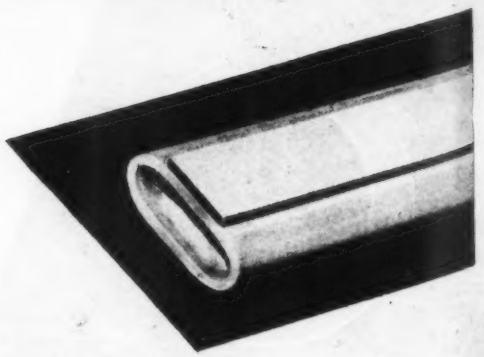
Marine evaporators have one big drawback. Salt scale builds up on the tubes so fast that operating efficiency is severely impaired. Frequent cleaning is necessary—usually by scraping and chipping by hand.

Now Heat Transfer Products, Inc. has found a way to lick this problem. Using tubing of Admiralty Brass, they silver-braze a strip of Monel along the top. The *low* heat expansion of the Monel combines with the *high* expansion of the brass to produce a bi-metal action of just the right sensitivity. Result: *a tube that shrugs off scale as it works.*

Monel was used to team up with brass in this labor-saving tube because it uniquely combines all the properties needed. It is highly corrosion-resistant... has 32% lower thermal expansion than Admiralty... is readily silver-brazed... possesses the strength and resilience to take repeated flexings... has good heat transfer properties (important since the strip occupies 20% of the tube's area) ... and is galvanically compatible with brass.

Other combinations of metals can be used to meet corrosive conditions in heat exchangers, stills and condensers designed for process service. For example, the same type of self-descaling tube may be made by using *Inconel* tubes with *stainless steel* (18-8) flexing strips or any other combination of corrosion-resistant materials which provides the necessary difference in coefficient of expansion.

"Properties of Some Metals and Alloys" is a handy reference booklet that lists coefficient of expansion along with other frequently-sought data on 104 metals. Send for your copy.



Cross section of tubing... Admiralty Brass with strong flexing "Muscle" of Monel. Used in hundreds of industrial applications because of its combined strength, toughness and corrosion resistance, Monel combines with Admiralty to form the self-descaling tubing that shrugs off scale, as shown in the accompanying sketches.

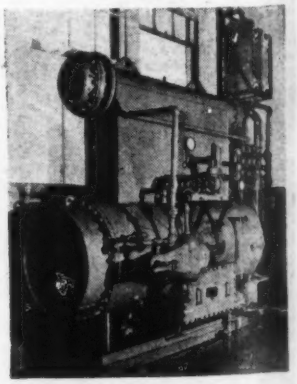


Photo courtesy of U. S. Merchant Marine Academy

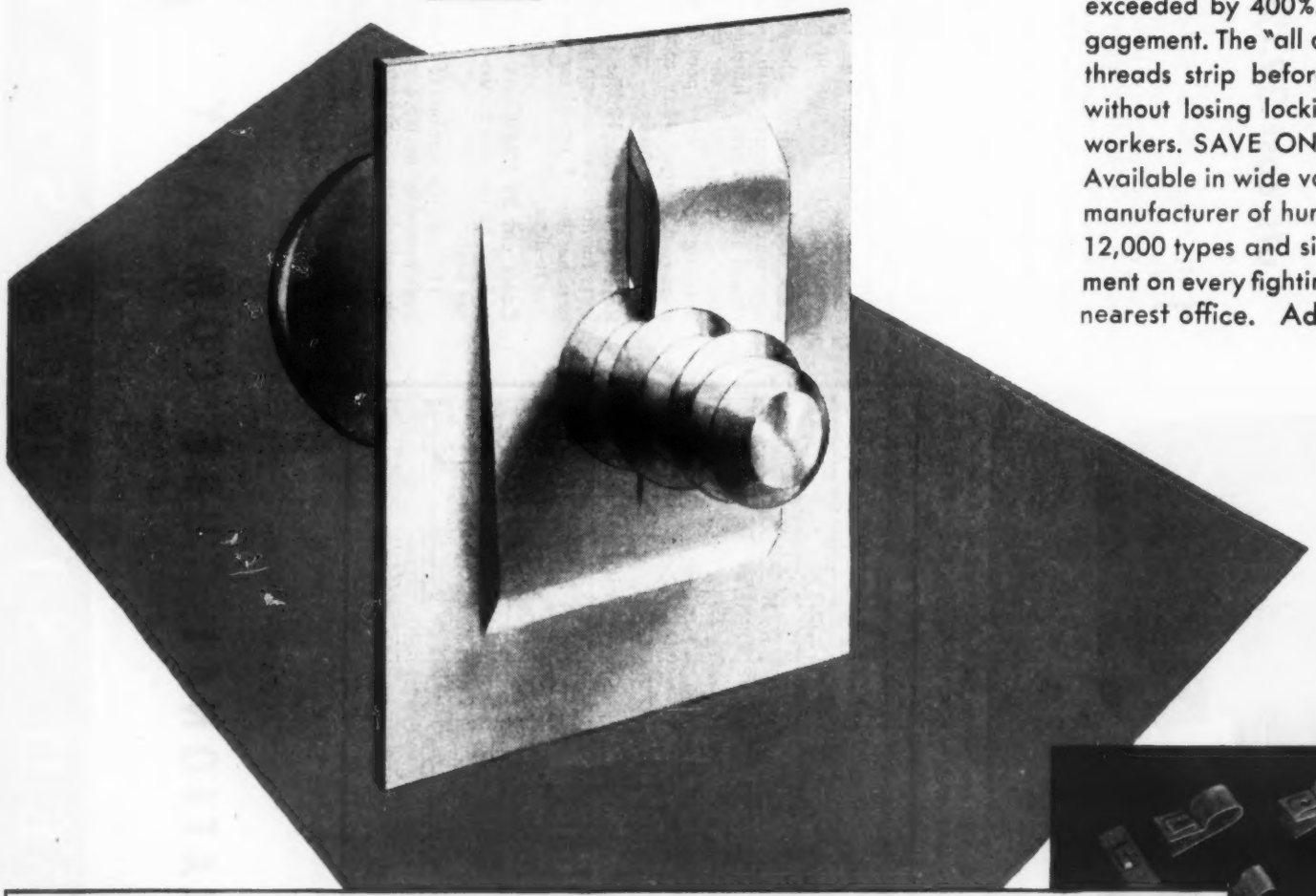
SELF-DESCALING BI-METAL TUBES (U. S. Pat. 2,279,066) *are used in this marine evaporator, made by the Heat Transfer Products, Inc., 90 West Street, New York, N. Y. It produces 50 tons of fresh water daily from the sea, but the self-descaling tubes make unnecessary the slow costly removal of scale by scraping; assure continuous fresh water supply; increase operating efficiency of still.*

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall St., New York 5, N. Y.

NICKEL (INCO) ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL • Sheet...Strip...Rod...Tubing...Wire...Castings...Welding Rods (Gas & Electric)

STALOCK



You, too, will say, "They're THE Nuts!" when you double-check their many advantages. Tests show performance far exceeds AAF Spec. No. 25533. Vibration requirements exceeded by 400%. Positive locking action. 360° thread engagement. The "all around locknut." Under tension tests screw threads strip before nut fails. May be re-used repeatedly without losing locking efficiency. No sharp edges to injure workers. SAVE ON ASSEMBLY TIME COST AND WEIGHT. Available in wide variety of types and sizes. Made by ADEL, manufacturer of hundreds of millions of line supports in over 12,000 types and sizes, now serving Allied armament equipment on every fighting front. For catalog and information, call nearest office. Address Department N-400.

Patents Pending.

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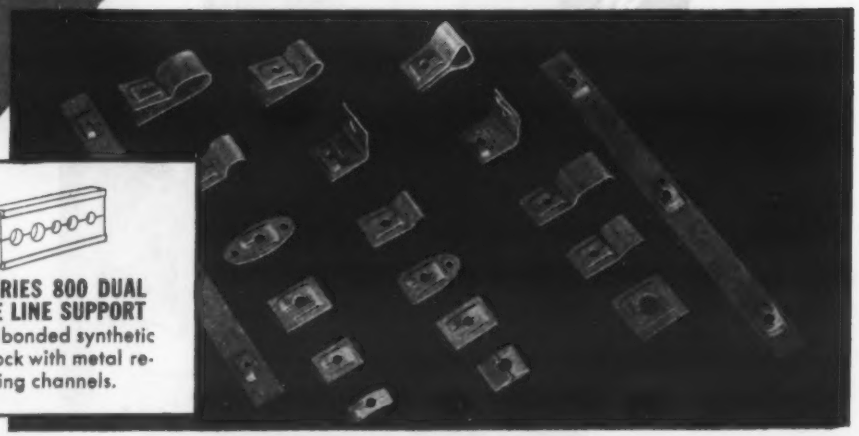
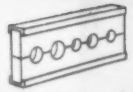
Offices: Seattle 1, Wash.; Dayton 2, Ohio; Detroit 2, Mich.; Hagerstown, Md.; Baltimore 1, Md.; New York 20

AFTER VICTORY — Products for Home and Industry



ADEL 668 HARNESS STRAP
Adjustable harness strap assembly for group wiring.

ADEL 716 CABLE MARKER
Cable marker for cable or conduit. Colored finish or embossed coding.

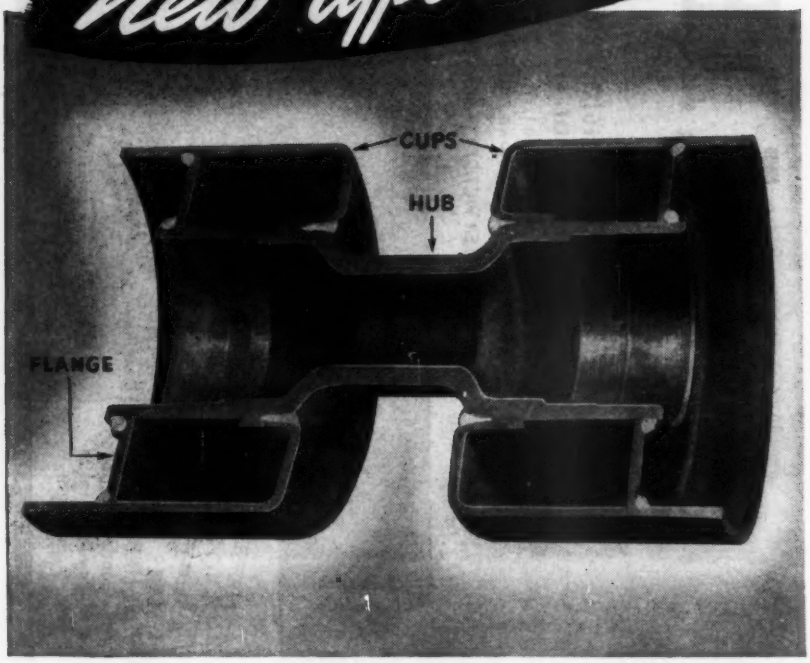


ADEL SERIES 800 DUAL PURPOSE LINE SUPPORT
Integrally bonded synthetic rubber block with metal reinforcing channels.

ADEL 755 LINE SUPPORT CLIP
Standard integrally bonded supporting clip with synthetic rubber cushion.

ADEL 724 CABLE STRAP
Double hole cable strap for marine use on non-water tight bulkheads.

New type roller designed with SEAMLESS STEEL TUBING



Cutaway section through top roller used on army half-tracks. Center-hub section is made from seamless steel tubing "spooled" to proper shape.

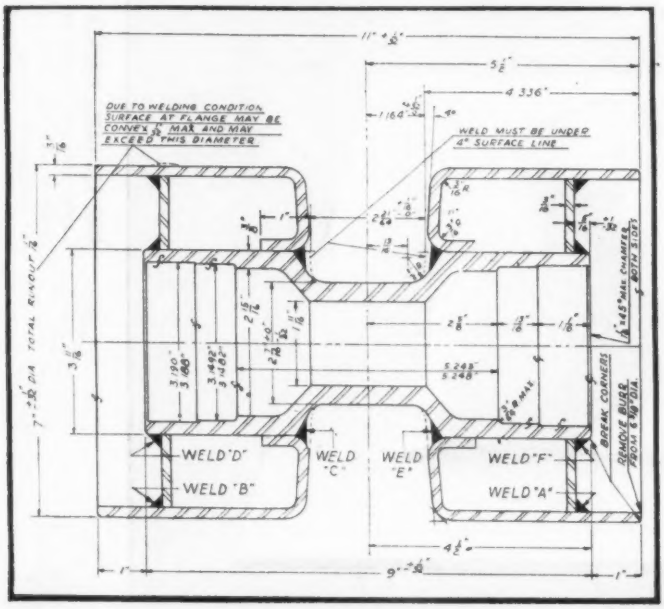

DUE TO WELDING CONDITION SURFACE AT FLANGE MAY BE CONVEX MAX AND MAY EXCEED THIS DIAMETER
WELD MUST BE UNDER 4" SURFACE LINE
WELD "D"
WELD "B"
WELD "C"
WELD "E"
WELD "F"
WELD "A"
BREAK CORNERS
REMOVE BURR FROM ID & OD

Diagram of roller showing how flanges are fitted to tubular hub to make one piece unit.

Saves 38% in steel
Reduces rejects 100%
Cuts cost 39.1%

THIS "top" roller for half-tracks supports the continuous crawler tread as it returns along the upper portion of its travel. In former practice, out-of-balance rejects were running as high as 20% in regular production. Obviously something had to be done.

Careful study of the problem led to re-design of the unit. The new roller was made from Seamless Steel Tubing for the hub with rolled steel plates for cups and the closing end flanges (see diagram). These are assembled to form a one-piece unit by arc welding. Because all the processing operations involved lend themselves readily to handling on high production equipment, this roller is particularly suitable for manufacture by mass production methods.

38% Steel saved: Weight of the former design was 42 pounds with 14½ pounds machined away to give a finished weight of 27½ pounds. The weight of the new design before finishing is only 25½ pounds with *only* 1½ *pounds* machined away to obtain a finished weight of 24 pounds.

Rejects reduced 100%: Out-of-balance rejects formerly ran as high as 20% but not one unit has been rejected for this cause since it was re-designed.

Costs cut 39.1%: Costs have been reduced to $6.69 by the new method—a saving of $4.31 per unit.

This roller is just one of many war jobs that have been done better, faster, and at lower cost through the use of Seamless Steel Tubing.

When planning for peace products, plan to take advantage of cost-cutting methods made possible through SHELBY seamless steel tubing.

NATIONAL TUBE COMPANY
PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

WALLS WITHOUT WELDS

UNITED STATES STEEL

WHAT DOES AMERICA WANT?

IT IS THE PURPOSE of this editorial, the thirty-first of a series, to state the urgent need for a clear declaration of American policy in world affairs.

Within the past few weeks there has been a wakening conviction in this country that the determination of international arrangements cannot safely be put aside until victory has been won. For we have seen actions taken in Europe seemingly without full consultation and agreement of the Allied powers, which may profoundly affect the design of the post-war world.

A declaration of American policy is needed, and it should be accompanied by a statement of our firm intention to exert full effort to procure its acceptance and furtherance. Emphatically, this does not mean that an American platform should be put forth as an ultimatum, which other nations must accept totally, or reject at the cost of having the United States withdraw from collaborative participation in world agreements and organization. On the contrary, the first plank in such an American platform should be a firm commitment on our part to participate with our associate nations in building a general system of world security and order. By definition, this requires that each participant be willing to accommodate its purely national interests to a program that can be accepted as fairly representing the interests of all. But equally, there is imposed on each participant an obligation to state honestly and openly what it conceives its individual interest to be, as well as its concept of what measures will best serve the general interest.

☆ ☆ ☆

Americans have displayed a singular diffidence in the matter of formulating a bill of American objectives—singular, in that it contrasts so sharply with our power to exercise as broad a leadership as we are able to define. This reluctance stems partly from the inherent difficulty of arriving at a coherent statement of national aims in a country like the United States—so vast in area, so multiple in its sectional and group interests, and so soundly committed to the free expression of individual thought. But it stems also, in part, from a tradition of national isolation which, however understandable in historic perspective, now stands clearly discredited by two world wars which were not of our making, but from which we were unable to hold aloof.

That the economic wellbeing and political security of the rest of the world is closely bound to the decision and performance of the United States is questioned nowhere but in America. Political boundaries and restrictions cannot build effective fences against the interplay of economic forces, and the sheer weight of American economic influence is of crucial import to all the other nations of this globe. In large measure their decisions will be shaped either in response to the opportunities that our procedures offer them, or in defense of interests that our procedures may jeopardize.

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The United States contains only about 6 percent of the world's population. But—our national income, before the war, amounted to almost 25 percent of world income; our industrial output as a whole approximates 45 percent of world totals, and we now are producing a like percentage of the world's munitions; we have 35 percent of the world's railroad mileage; 25 percent of merchant fleet tonnage; 50 percent of the world's telephones; 45 percent of steel production; 40 percent of aluminum production; 33 percent of coal output; we are refining (though part of the production comes from imports) 55 percent of the world's copper, and 70 percent of its petroleum; we now are producing 50 percent of the world's rubber (though post-war resumption of natural rubber production will sharply reduce this balance); our shares of agricultural production are, of course, much smaller, but just before the war we accounted for 35 percent of world cotton production, 15 percent of wheat, and 10 percent of wool.

Whether we like it or not, we must exercise political responsibilities commensurate with the weight of our economic power in an inter-dependent world. But before responsibilities can be assumed, they must be defined. Can the United States arrive at a clear agreement and statement of aims for which it is willing to stand sponsor?

The recent campaigns of both political parties have helped to provide an encouraging answer. In general, election mandates are glaringly deficient as indicators of a unified national purpose. A majority of voters declare themselves for the winning candidate. But even among the majority there are varying degrees of enthusiasm for the platform principles espoused by their candidate; and the substantial minorities of the defeated parties may have had no enthusiasm whatsoever for particular planks in the winning platform, or for the platform in its entirety. A sportsmanlike deference to the will of the majority is a feeble substitute for unified national conviction.

But this Presidential campaign was noteworthy for certain basic principles upon which both the platforms and the candidates of the major political parties were

united. Surely, upon such areas of agreement there may be said to have been an American mandate; the more so, because upon certain of them, we have evidence that no party or candidate could have declared opposition with any hope of victory. What then were these agreed-upon principles? The following is an attempt at a fair summary:

1. That America, in collaboration with its Allies, is committed to seeing the war through to the unconditional surrender of our declared enemies.

2. That America is committed to a responsible role in a world security system after the war, including a commitment to lend the support of our armed forces to repel aggressions that may violate such security.

3. That America is committed to the post-war goal of substantially maintaining in this country an economy that will provide jobs for those who are able and willing to work.

4. That America is committed to the principle of achieving this goal of sustained, high-level employment of manpower and economic resources under a system primarily activated by competitive enterprise.

These are American mandates. They can be made the nucleus of a coherent national policy, for they define aims upon which the great majority of our people are emphatically agreed. But no one can pretend that in this generalized form they serve as more than directional guides for either internal legislation or international negotiation. This skeleton of aims must be clothed with the living flesh of agreed-upon means. Here we have no national mandates of comparable clarity, but it is patently clear that it is our compelling task to achieve them.

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On our elected representatives in government rests the primary responsibility for formulating the specific programs required to implement national policies. Under our system of government, those representatives need continuous nourishment in the form of mandates as to what the people want. Particularly during a period when so many urgent problems are being thrashed out upon an international basis, this imposes a grave responsibility upon all sectors of our citizens; for it requires them to think in terms of the welfare of our nation as a whole, to focus upon those points which offer possibilities for substantial agreement among Americans, rather than upon matters of individual, group, or sectional advantage.

In earlier editorials I have tried to define a basis for national policy in keeping with that broad purpose. They have dealt with problems that are basic to the healthy functioning of free enterprise under the competitive system, with the mobilization of our resources for war and for reconversion to peace-time production, with labor and management responsibilities and relations, with national debt and taxation, with foreign trade and our economic relationships abroad, with the industrial development of backward areas. Since they have been presented in the McGraw-Hill publications, which reach a group broadly representative of all American industry, they have centered upon problems that have an economic rather than a strictly political import.

Future editorials, to appear during 1945, will deal with comparable subjects selected in recognition of the urgent importance for arriving at concerted definitions of national policy. I am fully aware that no individual or group can speak authoritatively for the American Nation. But I hope that an honest attempt to formulate sound concepts of national interest in crucial economic matters will help to crystallize American policy both by focusing agreement and by eliciting dissent.

☆ ☆ ☆

Here there is space only to indicate in broadest outline what I conceive to be desirable foundations for an economic policy for the United States:

1. The attainment of a high and sustained level of business activity and employment in the United States and in the world.

2. Active and expanding markets for world trade based upon fair competition rather than upon bloc agreements, discriminatory preferences, and cartel arrangements.

3. The encouragement of industrial development in nations that have been backward in that respect.

4. A recognition that hospitality to imports, rather than constituting a threat to national standards of living, offers in fact the most potent instrument for international bargaining that any nation can command.

5. A willingness to assume a responsible national role in international arrangements designed to provide such financial stability as may be needed to support mutually advantageous world exchange of goods and services.

We must see to it that the end of military warfare does not merely open the door to an era of economic warfare.

The fact is that America has no choice but to assume leadership in world affairs. For the weight of our influence will be felt by other nations no less whether our attitude be positive or negative. And the cost to us of any international obligation which we might undertake must in all fairness be weighed against the equally real cost to us of dealing with measures that others may take to protect themselves against the results of our non-participation.

We have tended in the past to approach international commitments timidly, fearful that we might be outwitted in a world battle of wits. And in so doing, we have too often ceded to others the initiative of suggestion, leaving to ourselves the thankless task of accepting or rejecting what they demand of us.

Our one bargaining weakness stems from the fact that other nations, by contrast feeble in potential power, know what they want and are able to mobilize all their strength to achieve it.

America can be the most effective nation on earth—if only it knows what it wants.

President McGraw-Hill Publishing Co., Inc.

late for a date?

... not in the NAVY!

★ You may be late for a train . . . or a conference . . . even late for work (although "tardy-ism" doesn't help the war effort) ★ but if you're in the Navy . . . on patrol duty . . . convoy duty . . . or in an invasion force ★ punctuality is not only a tradition but a matter of success or failure ★ Navy chronometers are delicate yet dependable mechanisms, timing with split-second accuracy the operation of every objective (not more than 3/100's of a second loss in 24 hours is the requirement of these timepieces) ★ Helping American watchmakers to achieve this accuracy are Barnes-made springs ★ made of Barnes-made spring steel so finely processed that it has surpassed all others in quality and performance for the purpose ★ This same steel will be available for the new applications of civilian developments to come.

DESIGN WISELY TO CONSERVE METAL

1918—THEN AND NOW

ARMY NAVY

Barnes-made Springs

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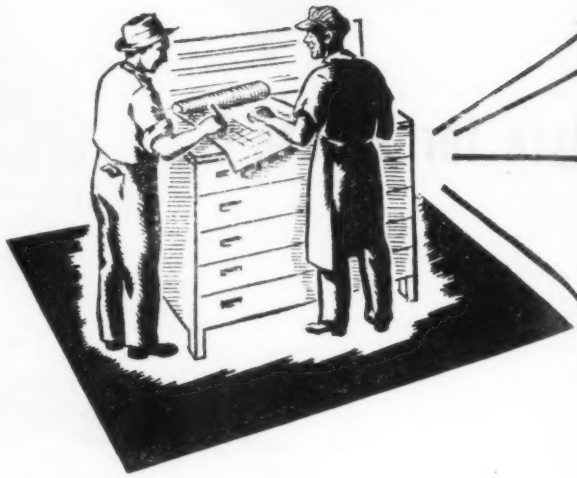
You Get Corrosion Resistance *Plus* EASY, ECONOMICAL FABRICATION with Carpenter Stainless



When you consider putting new zest, greater "eye" appeal into your new or redesigned products—when you consider giving them greater strength and a higher factor of safety—when you consider endowing them with special physicals to meet unusual service conditions—the first thing that comes to mind is "Let's make it from Stainless."

But beyond these immediate sales and utility advantages, you want Stainless Steels that will work with you right from the start.

Easy-working Carpenter Stainless Steels for instance, can help your shop get into production faster. Because they form easily, blank cleanly and permit faster press and machining speeds, they smooth the way from drawing board to finished product. In addition, these Stainless Steels save time and expense in the finishing room.

Carpenter has spared neither time nor expense to bring you the easiest fabricating Stainless Steels that ever hit your production line. The same group of Stainless experts who helped make possible ductile, easy-working Stainless Strip and Free-Machining Stainless bar stock are ready to apply their experience to your problems. Let them help you select the proper Stainless for the job. Let them help you cut corners and costs in your fabricating shop.

Call in your nearby Carpenter representative now, or write us at the mill. And if you do not already have a copy, send for our 98-page book, "Working Data for Carpenter Stainless Steels." A note on your company letterhead, indicating your title, is all that is necessary.

Give Your Products These Advantages

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- No Plating to Peel
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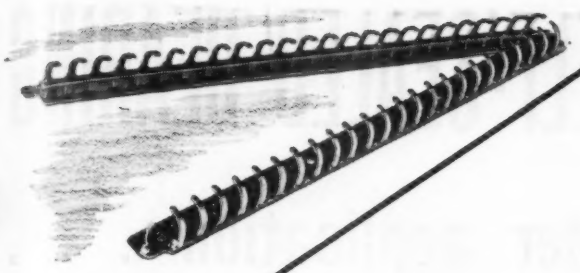
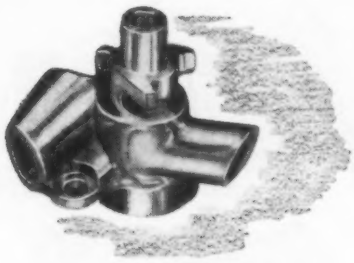
- Strength and Rigidity
- Ease of Assembly
- Fewer Service Complaints

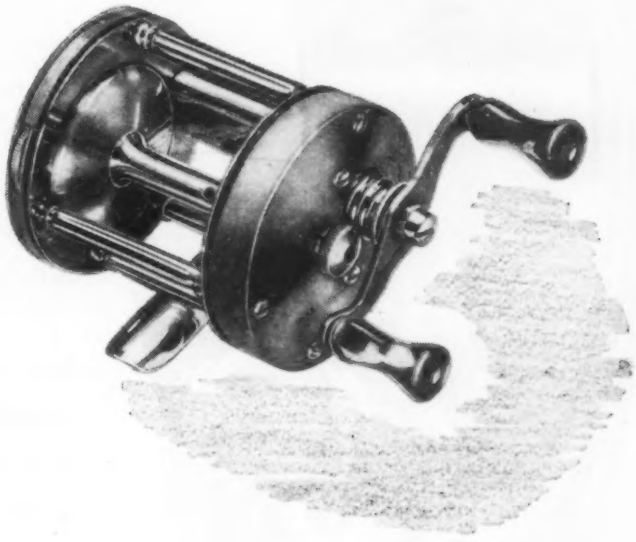
more than corrosion resistance



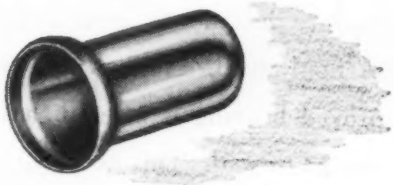
SAME DIES as were previously used to form and blank ordinary cold rolled strip, later made this ingenious Stainless loose leaf binder. Ductile, uniform Carpenter Stainless #6 assured clean stamping, easy crimping, smooth bends. In addition, this satin-finish Stainless eliminated all polishing operations.



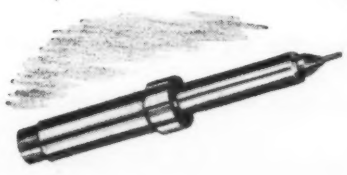
LOWER UNIT COSTS This aircraft fuel supply valve body was forged from Carpenter Stainless #8 forging bars. Our *machine-turned* billets from which all Carpenter Stainless forging bars are rolled, assure freedom from surface defects. The result: sound, flawless forgings for you, with minimum rejects.



PERMANENT "EYE" APPEAL When manufacturers of equipment like fishing reels want to give their products lasting beauty that never peels off, or becomes marred by rust, their natural choice is Stainless. And when the job combines forming, stamping and machining operations, they find Carpenter Stainless Steels save time and expense through every step of fabrication.



NO PROCESS ANNEALING Ordinarily a difficult deep-drawing job like this could cause plenty of headaches and expense. But with Carpenter Stainless #6 the cups were easily deep drawn and without process annealing. Do any parts for your postwar products involve deep-drawing? If they do, investigate easy drawing Carpenter Stainless Strip.



AUTOMATICS USED This airplane part, machined in automatics from Carpenter Stainless #8 bar stock, indicates what can be done with Free-Machining 18-8 Stainless.

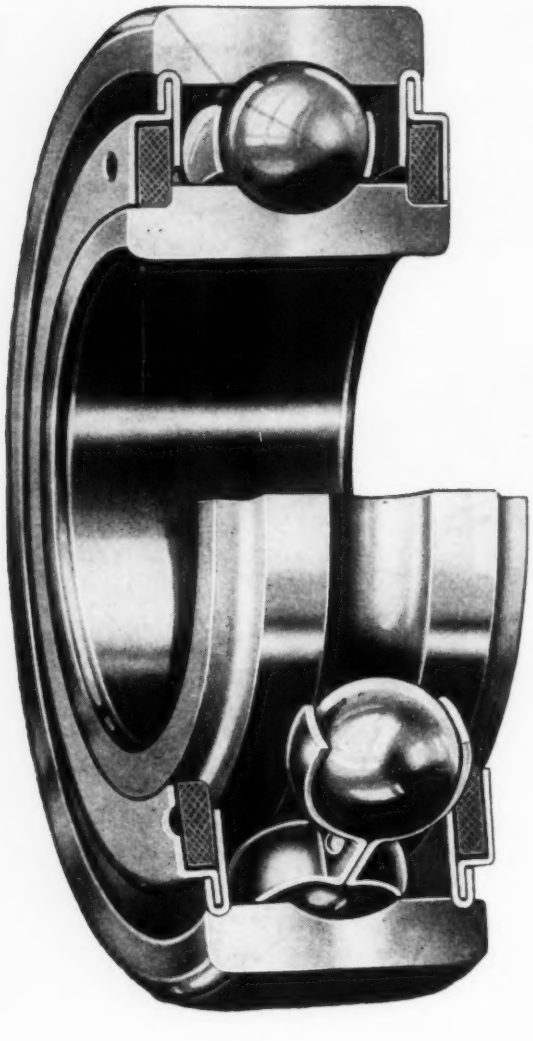
THE CARPENTER STEEL COMPANY, 117 W. BERN ST., READING, PA.

Carpenter STAINLESS STEELS

BRANCHES AT Chicago, Cleveland, Detroit, Hartford, St. Louis, Indianapolis, New York, Philadelphia

Announcing a SELF-SEALED BEARING

for wider application . . .



The originator and largest maker of self-sealed ball bearings offers further improvements, advanced design, for an even greater range of operating conditions.

Since New Departure introduced the first self-sealed ball bearings less than two decades ago, pyramiding demands have required the production by this company of more than 75 millions of these bearings. Better than words, such figures tell the story of the excellent service ND-seal bearings have delivered in virtually every kind of industry.

But, New Departure has never been content to let "good enough" be the final word. Now, with basic principles retained, an improved bearing is offered, having a new, even more efficient design of seal. This new seal not only prevents entrance of dirt or leakage of lubricant at low speeds or any mounting position — but, it is relatively frictionless and extremely efficient at very high speeds.

. . . AND in addition

a method is provided in these bearings whereby fresh lubricant can quickly revitalize the old, thus vastly extending their utility, and particularly where operating conditions are unusually severe.

This method of refreshing the lubricant does not require removal of the bearing from the housing. Neither does it involve the use of nipples, grease passages, plugs or removable seals. Further details will gladly be sent upon request. Ask for pamphlet IB.

nothing rolls like a ball

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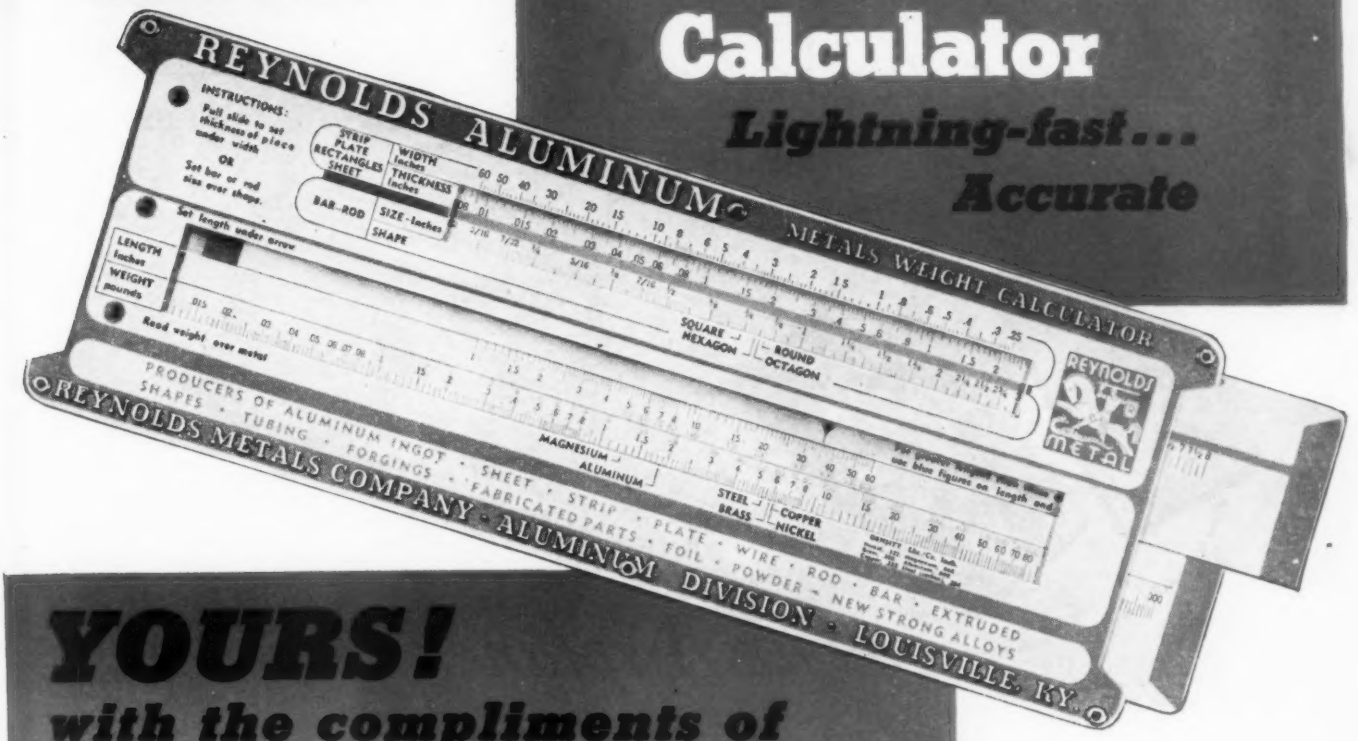
Metals Weight Calculator

Lightning-fast... Accurate



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A REAL TIME-SAVER. Engineers report that, besides facilitating absolute accuracy, the Reynolds Metals Weight Calculator saves up to 90% of the time ordinarily required to consult tables and make calculations.

Here is one of the handiest calculating devices ever developed.

All the answers INSTANTLY. Everyone who works with metals will find this instrument invaluable.

It does the work for you, saves up to 90% of the time and effort on weight calculation. Just make the settings—then read the results. Serves equally well with aluminum, steel, brass, copper, magnesium, and nickel.

The Reynolds *Metals Weight Calculator* is a convenient, durable, vestpocket-sized instrument, measuring only 3"x 8¾". With a flip of the finger, weights are calculated from cross-sectional dimensions and length as accurately as from published tables of theoretical weights. It can also be used to determine lengths from cross-sectional dimensions and weights.

Scales included are sheet, strip and plate; round wire and rod; square, hexagonal, octagonal and rectangular bar; tubing; and sheet circles. Range of instrument—from .0006 lbs. to 3000 lbs. —from an infinitesimal-sized piece of metal to a giant bar.

If you work with metals, you will find this Reynolds *Metals Weight Calculator* very helpful. Mailed post-free upon request, in a protective wrapping.

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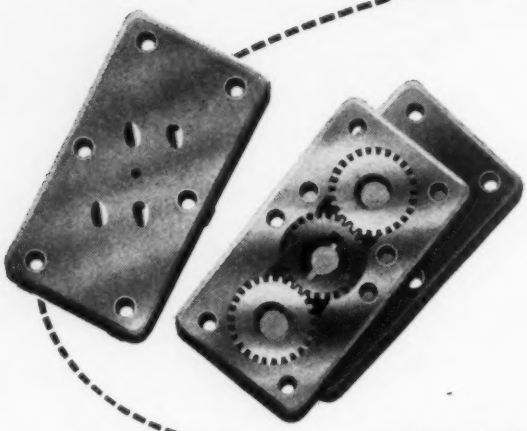
ANOTHER MASS-PRECISION ASSEMBLY BUILT BY NICHOLS

Putting the "No Ice" Sign



on an Airplane's Propeller

A propeller blade is certainly no place for an ice-pack. Neither is a pilot's windshield. Yet every drop of freezing rain that strikes these surfaces is potentially ice-forming... and dangerous.

W. H. Nichols & Sons has helped combat this natural "enemy" by producing a unique precision pump for an anti-icing unit which "beats ice to the draw" by spreading a thin film of alcohol on these exposed surfaces. The mixture of alcohol and rain with its lower freezing point quickly flies off as harmless vapor instead of turning to ice.

Metering such a thin fluid as alcohol with *exact, measured* distribution to both engines in a bi-motored plane presents many unusual manufacturing requirements. The pump must operate *completely without lubricant* to insulate the rubbing surfaces from one another. This means fine, flat surface finishes and strictest dimensional accuracy. Since the whole unit is powered by the plane's limited electrical supply, complete freedom from binding is essential.

Nichols mass-produced the close dimensions required... gears thicknessed to plus 0" minus .0001"... side plates flat to .0002" over 3½" length... bores in the centerplate held to plus .0002" minus 0". A high production rate was constantly maintained *without pre-selection of any parts* and the cost kept low.

Such performance is typical of Nichols' forty years of mass-precision manufacturing ability. Here unique facilities have been developed for producing the "hard" parts.

Perhaps you have an unusual precision problem—part or assembly—which can benefit from such a tradition of accuracy in mass-production. Talk it over with "Accurate" Nichols.

W. H. NICHOLS & SONS, WALTHAM 54, MASS.

"Accurate" *Nichols*

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There's no more dramatic proof of Lumarith's toughness than its use in the advanced rocket equipment of the Thunderbolt and other famed warplanes.

Think of the great strides plastics have achieved to meet the challenges of war needs. If your peacetime production plans include the use of advanced plastics, we urge you to consult our Technical Service Department. Its staff welcomes challenging problems of reconversion.

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*Reg. U. S. Pat. Off.

Reproduced from original designed for the September issue of Air News by Robert Lindgren, Art Editor.

ECONOMY!

—ANOTHER ZINC ALLOY DIE CASTING CUTS COST AND IMPROVES APPEARANCE

The restaurant-size can opener shown* provides one of many case histories attesting to the economies of zinc alloy die castings. This device, as you see it, is composed essentially of cast iron parts. Now the manufacturer has adopted a zinc alloy die cast body with a steel arm cast as an insert (right). This casting costs less than 50 cents *complete,* whereas the machining of the former cast iron body *alone* cost approximately $1.00.

Add to this saving the elimination of an assembly operation in fastening the arm to the body. Take into account, also, the improved appearance due to the smooth as-cast surface of the die casting. The result is typical of the economic and physical improvements achieved in many widely varied products today through the intelligent use of zinc alloy die castings.

Economy is just one of many inherent advantages which make die castings of zinc alloy the most widely used under normal conditions. *Every die casting company is equipped to make zinc alloy die castings,* and will be glad to discuss all of their advantages with you —or write to The New Jersey Zinc Company, 160 Front Street, New York 7, N. Y.

*This can opener is now widely used by the Armed Forces.

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FOR DIE CASTING ALLOYS

The Research was done, the Alloys were developed, and most Die Castings are specified with
HORSE HEAD SPECIAL (99.99+% Uniform Quality) ZINC

SUCCESSFUL DESIGN FOR PLASTICS DEPENDS UPON THE CORRECT APPLICATION OF SOUND DESIGN PRINCIPLES. A NEW TWENTY-FOUR PAGE DESIGN BULLETIN HAS BEEN PREPARED BY THE PLASTICS DIVISIONS OF THE GENERAL ELECTRIC COMPANY AND INCLUDES A LISTING OF MATERIALS, DESIGN CONSIDERATIONS AND MOLDING PROCESSES. FOR YOUR COPY WRITE TODAY TO SECTION F-25, ONE PLASTICS AVENUE, PITTSFIELD, MASS.

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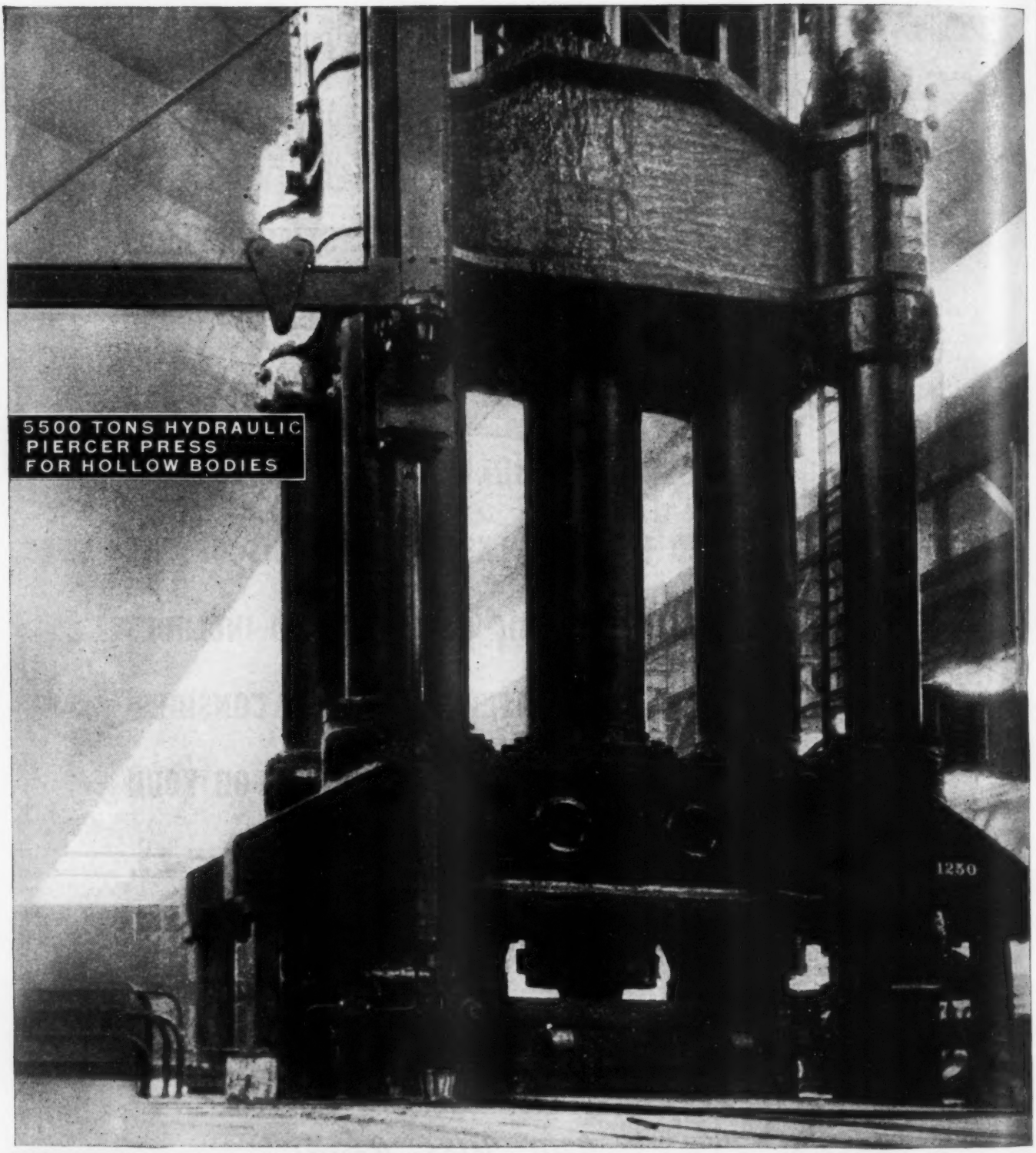

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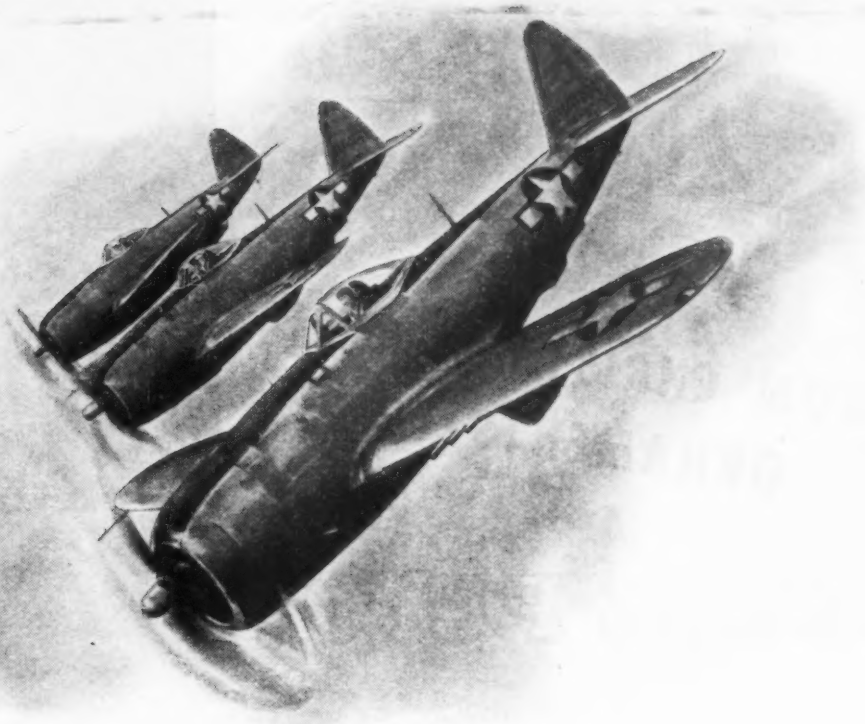
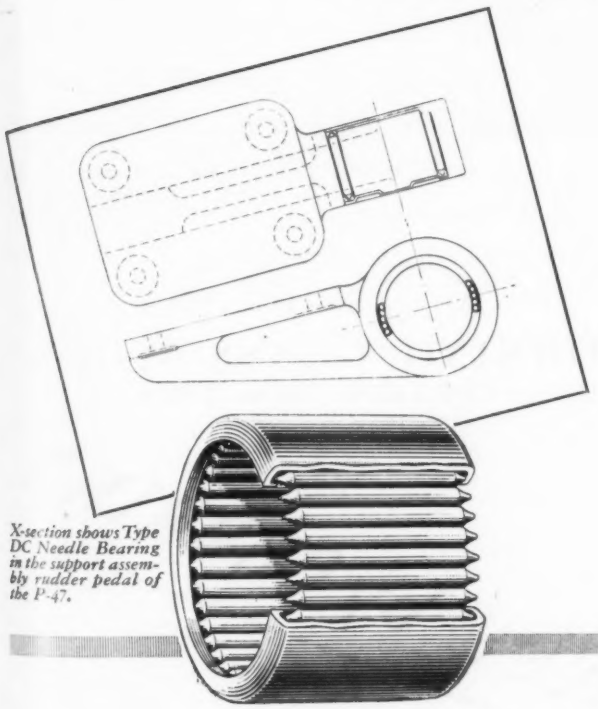


53 Torrington Needle Bearings Fly with the Republic P-47 Thunderbolt



X-section shows Type DC Needle Bearing in the support assembly rudder pedal of the P-47.

When you compare the advantages of Torrington Needle Bearings with the "must" requirements of aircraft engineering you see immediately why these modern anti-friction units are so widely used.

Their light weight, compact design, high capacity, greater stability and low friction coefficient offer a *combination* of advantages that is contributing to improved performance and increased efficiency in many fields.

With experience in thousands of different Needle Bearing applications, Torrington's engineering staff can assist you in securing maximum benefits of their use. Preview the possibilities *now* while your plans are on the drawing board. Send for a copy of the Torrington Needle Bearing Catalog which gives data on the range of types available for modern design needs.

THE TORRINGTON COMPANY

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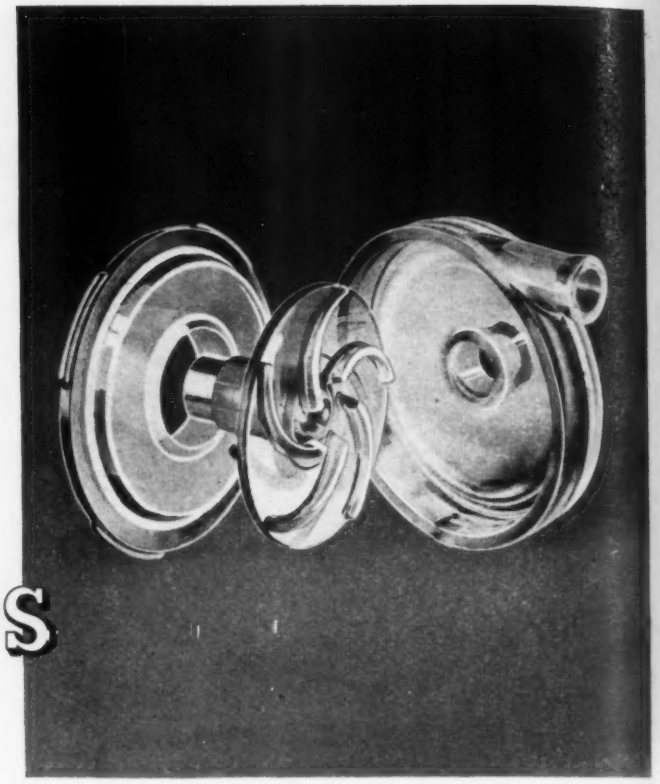
TORRINGTON NEEDLE BEARINGS

FROM CHRISTMAS TREE ORNAMENTS TO GLASS PUMPS



WHEN war cut off America's supply of imported Christmas tree ornaments, Corning stepped into the picture . . . adapted its production facilities to turn them out at the rate of hundreds per minute. And they were better, more rugged, more brilliant.

When chemical plants handling highly corrosive materials complained that their metal pumps were being eaten away almost as fast as they were installed, Corning was consulted. In cooperation with the Nash Engineering Company, a pump was developed in which the material being handled came in contact only with corrosion resistant PYREX brand Glass. Today these pumps are in constant day-in and day-out service.

These are extreme examples of the glass engineering problems Corning has helped to solve. Whether the problem involves beautiful decorations to be produced by the million with a sales and price appeal for the general public, or whether industrial parts of chemical resistant glass designed for serviceability and made to precision tolerances, to answer the rigid requirements of an engineer—Corning will be glad to work with you on the solution of your problem. Corning engineering service is available for the asking.

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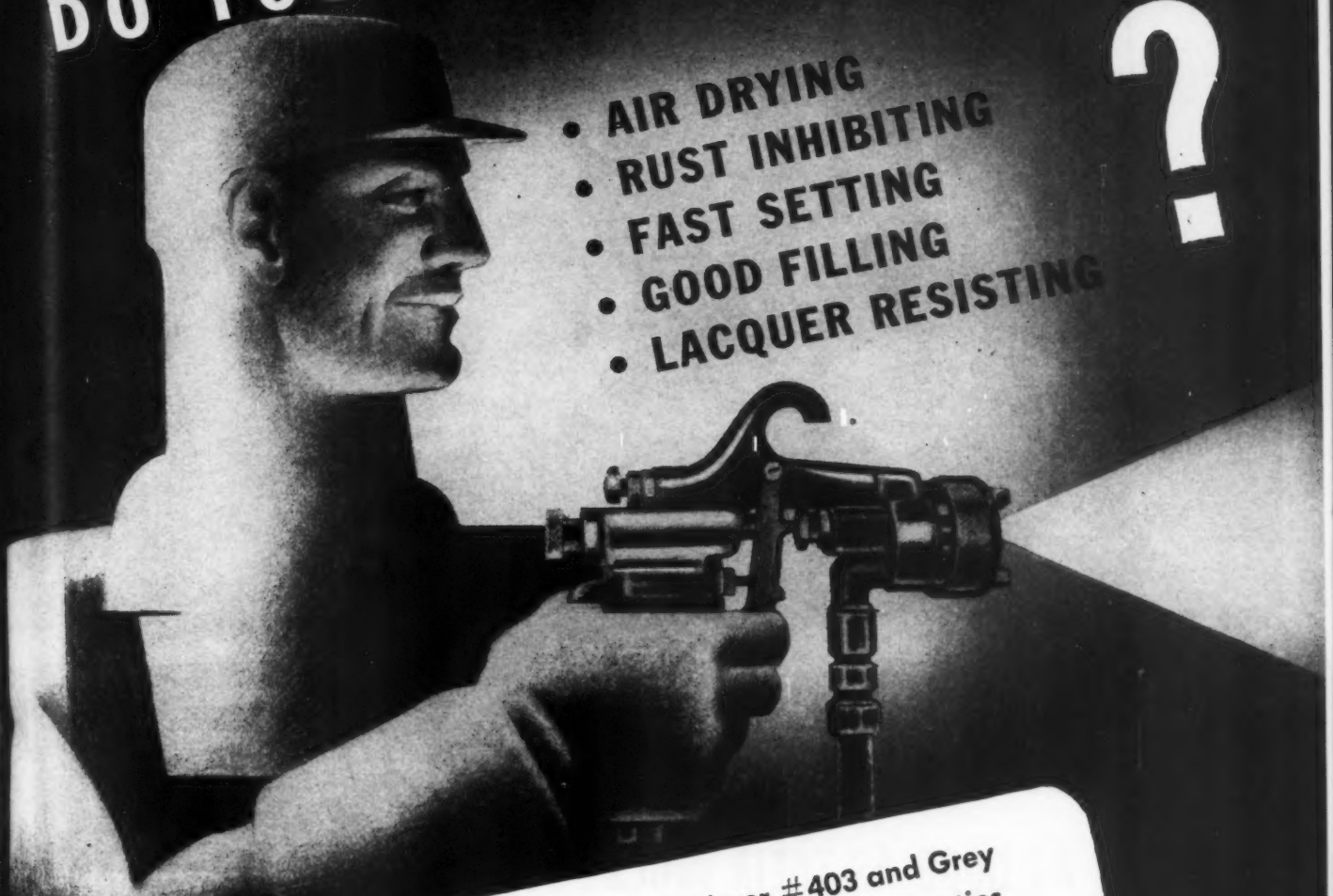
WHAT DO YOU NEED IN A PRIMER ?



- AIR DRYING
- RUST INHIBITING
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M & W's new Red Oxide Speed Primer #403 and Grey Speed Primer Surfacer #5 have all these properties and more. They were developed to achieve the results of a zinc chromate primer on metal surfaces where a fast-setting, corrosion resistant, air-drying or baking primer or primer surfacer is required. In some respects, they excel zinc chromate primers, as extreme care in their application to obtain a very thin transparent coat is unnecessary. They air-dry to recoat in 10 to 15 minutes and dry hard overnight; they can be baked in one-half to one hour at 250° F. Both materials can be coated with lacquer enamels after air-drying or baking.

Your inquiry will receive prompt attention.

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ARE AS GOOD AS THEIR TOOLS . . . .

● Up at the Yale and Towne Manufacturing Company in Stamford, Connecticut, craftsmen have been making the well-known "Yale" locks and builders' hardware for many years. The enviable reputation enjoyed by this company is the result of their insistence for fine quality.

Now as a major contributor to the war effort, Yale and Towne are producing hydraulic pistons and cylinders. Constantly endeavoring to improve their already superior quality, they use the Brush Surface Analyzer in both laboratory and shop. With this instrument they are able to study surface finishes, accurately measured to one millionth of an inch (.000001") from chart recordings instantly made as the specimen surface is explored.

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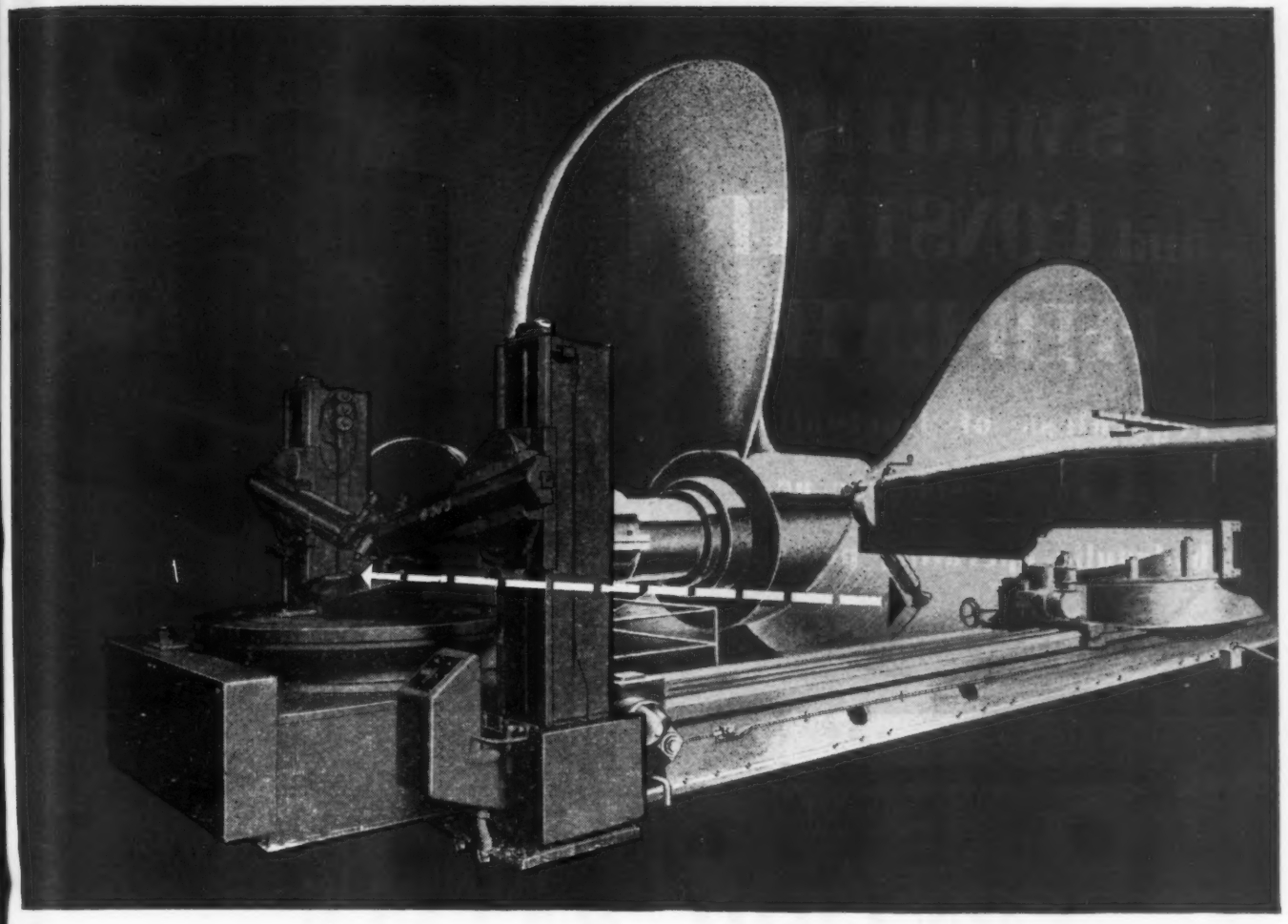

tracing perfect profiles...in steel

"BRAINS" OF THE ELECTRONIC CONTROL

Shown above is the Tracer Mechanism which translates the shape of the model into a signal pattern. This pattern, through the use of electronic tubes, controls the position of the cutters as they move over the full-size casting—reproducing exactly the shape of the scale model.

Finishing large nonsymmetrical surfaces—such as ship propellers—has long been an expensive and time-consuming job. Many days of skilled hand labor were required in chipping, grinding and polishing the rough casting.

But a war-born electronic development now permits the entire operation to be done by machine—with far greater accuracy than ever before possible with the most highly skilled hand labor.

An electrically controlled Tracer Mechanism follows the contour of an accurate small-scale model—made of metal, plastic or wood. The electronic position regulator (left) then guides the huge cutting machine over the full-size casting. Duplicates of the desired shape may be produced indefinitely from a single setup.

Now applied almost exclusively in production of ship propellers, this machine tool tracer control holds broad possibilities for speeding peacetime production, cutting costs, conserving skilled man power. It's another example of the new developments in electronics you'll want to know more about. For further information, call your nearest Westinghouse office, or write Westinghouse Electric & Manufacturing Co., P.O. Box 868, Pittsburgh 30, Pa.

J-91069

Westinghouse

Electronics at Work

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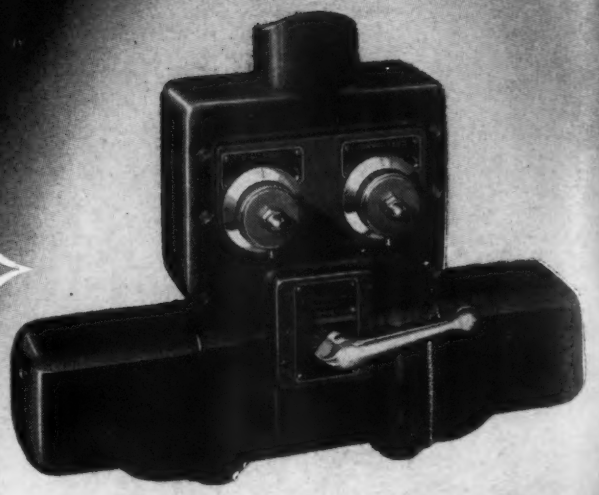
regardless of fluctuations in work resistance or hydraulic operating pressure



Double Solenoid Type
Push-button Operation

VICKERS "Traverse and Feed Cycle" CONTROL PANELS

These panels provide self-contained, compact control units for automatic machine applications where the cycle is a combination of rapid advance, one or two feeds, and rapid return motions. The two feed rates are infinitely variable within their ranges, and adjustments can be made during feed. Applications include drilling, reaming, boring, turning, milling and swaging machinery.

The hydraulic circuit in the panel employs the well-known Vickers Flow Control Valve in a "metering-out" circuit which means a smooth and constantly maintained feed rate for any given adjustment regardless of fluctuations in cutting tool resistance or changes in hydraulic operating pressure.

Simplicity is evident from the fact that there are only two working parts that move. Many standard modifications are available; feeds can be in either direction or both directions; operation is by single or double solenoids integral with panel, separate solenoids or pilot pressure. Practically any cycle sequence can be obtained. See Bulletin 41-10 for complete information.

Vickers Application Engineers will gladly discuss with you how "hydraulics" can be used to your advantage.

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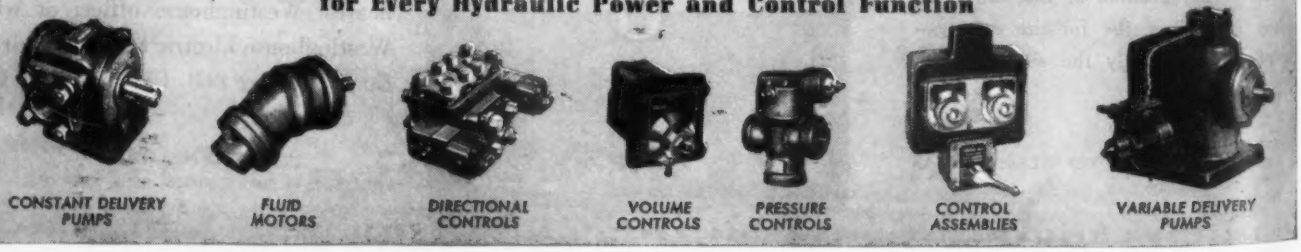


PRODUCT ENGINEERING

JANUARY, 1945

Engineering Teamwork Between America and Britain

Benefits of close collaboration between the two English-speaking nations during wartime should continue in the peacetime years ahead. A comparison of American and British technological concepts is presented. England's scientific contributions to wartime equipment is described

G. GEOFFREY SMITH, M.B.E.
British Supply Council

MR. SMITH is directing editor of a group of leading British technical journals, including *Flight*, *Aircraft Production*, *The Automobile Engineer*, *The Autocar and Motor Transport*. A captain of the R.A.F. in World War I and assigned mainly to development of aircraft engines, he has a wide background in aircraft and light engineering subjects. He was the first writer of turbine-jet propulsion. His articles years ago directing attention to the great potentialities of this new form of prime mover came at a time when few realized the significance of this revolutionary development. His latest book, "Gas Turbines and Jet Propulsion for Aircraft," first published in 1942 has run to several editions. Mr. Smith came to the United States in April at the invitation of Mr. Oliver Lyttelton, Minister of Production, to convey a better understanding of Great Britain's contribution to the war effort. At the end of his extended mission he will return to his work in England as directing editor of Iliffe and Sons, Ltd., Flight Publishing Company, British Plastics Press and the Louis Cassier Company.

IT IS really not surprising that American citizens generally have little understanding, and, I daresay, less appreciation of the activities of British designers and their contributions to the advancement of civilization. Absorbed as they are in the vast enterprises and development schemes in the U.S.A., the public by and large is not well informed of other nations' engineering activities. That observation could not correctly be applied to American engineers who make it their duty to keep "au fait" with world progress.

It is because of this situation that most Americans seem to have an idea that England is behind the United States in technological discoveries. In my travels to many parts of the United States over the past six months, I have made it a point to ask quite a number of people about home television. In almost every instance they expressed the opinion that within a few years after the war television receiving equipment would be found in many homes in America. A great deal of surprise was exhibited when told that over eight years ago television receiving sets were to be found in middle class English homes and that 18,500 television receiving sets were in use in homes within the boundaries of greater London when the service closed September 1, 1939. I daresay some of them more than suspected that I was, perhaps, exaggerating slightly. Now I learn that nation-wide television in color is forecast by the British Institute of Radio Engineers, as well as an extension of television to events across the Atlantic.

Over a period of several decades my peacetime duties have kept me in close contact with engineering developments in the United Kingdom. It has been my good fortune to spend several months of my present visit to the United States studying engineering design and development activities and visiting industrial plants. A greater part of the time has been spent in contacting manufacturers of aircraft and aircraft engines, but I also had the opportunity of discussing design developments with engineers in other fields of industry. With

this first-hand knowledge of the undertakings in both Britain and America I have been able to draw some obvious conclusions, which I daresay anyone else possessing the same facts and experiences would share. The most significant fact is that there is very little clashing of interests between American the British engineers. The reason lies in the vast difference between the environments of the two nationalities.

The United States of America, blessed with an abundance of natural resources and a national tradition that is rooted in the pioneering spirit of the early colonists, naturally puts forth its greatest effort in making the possible products of industry available to the masses in the speediest possible time. It was American industry that achieved the miracle of mass production. This miracle was achieved not only through the ingenuity of the nation's production engineers but also by the shrewdness of design engineers in creating designs most suitable for mass production systems. Indeed, today in all your aircraft factories we find the production engineering department. The sole duty of the engineers in this department is to modify the designs of the product development department to make those designs most suitable for rapid and economical production with a minimum of man-hours.

This is by no means a criticism of American industry and engineering. Indeed it is a great compliment. It is universally recognized even by our common enemies that it was the superabundance of high quality war materiel pouring out of American factories to supplement Allied material that turned the tide of battle at Stalingrad, on the deserts of North Africa, the landings on the shores of Sicily and Italy and finally the great D-Day invasion. German captive officers expressed amazement at the abundance of equipment and its quality and variety. No one can dispute the fact that the American excels in the development of designs perfected not only for serviceability and functioning, but also perfected for the mass production system.

Training Comparisons

When you stop to contemplate the engineers who achieved this modern miracle and when we compare them with the British engineers and their magnificent production effort accomplished with reduced manpower, we find slight differences in the education and training of these two groups. Both are thoroughly trained in the fundamental sciences although it seems that British engineers obtain perhaps a more concentrated education in basic engineering. On the other hand, the students of engineering in America have instilled in them during their college and university courses the importance of economical mass production. It seems ironical that apparently by reason of our watchword of "Quality," British engineers attach more importance to manual shop work and finish than do the American technical universities. In England it is generally expected that the graduate of an engineering university should be practical and able to turn out simple pieces on a lathe, drill press and other shop tools.

From my limited knowledge of engineering educational institutions in America, gained primarily from discussions with engineers, it seems that the American engineering instructors are mostly concerned with teaching the students what can be done with the proper production machinery rather than requiring them to be able to do it themselves. I do not criticize this fact but I recognize it as a corollary to the American theme of mass production.

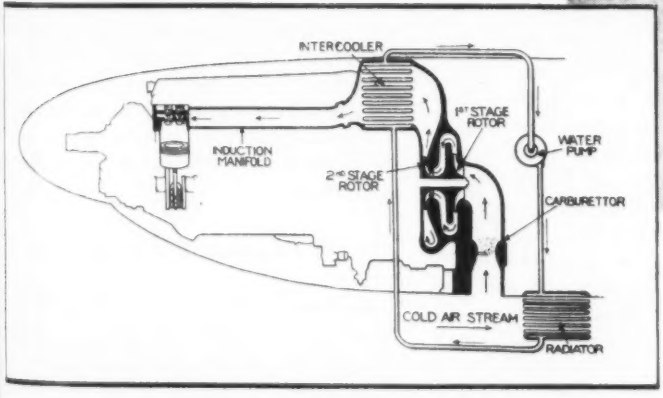
Great Britain is noted for its production of high quality machines and products, and English manufactured goods have an enviable reputation throughout the world. But these products are not produced on the mass basis in the American acceptance of the term. In the English factory quality and bulk production are practiced; but compared to U.S.A. we still expend a great deal of labor on hand fitting, a procedure frowned upon by American manufacturers. As in all periods of intensive production, Britain's manufacturing technique has again been modernized in this war. The latest labor-saving shop equipment has been fully utilized, the value of conveyors and track assembly systems again demonstrated, their uses vastly extended. Britain's production planning and manufacturing technique were never so highly developed. Peacetime products will materially benefit from this wartime experience of large scale manufacture.

A study of scientific discoveries shows that, in spite of the prevailing opinions to the contrary, many of the modern inventions had their birth in Britain. Indeed, some of the inventions that have played their dominating part in the winning of this war are the products of English or Scottish laboratories and engineering departments. To mention only a few: England produced

Many engineering accomplishments of this war can be traced to the fundamental technology projected by eminent British scientists of the 19th Century, among them James Watt, W. S. H. Cavendish, William Allen, Humphrey Davy, C. M. Faraday, Boulton, Cartwright, Murdock, Kelvin, Rumford, Joule, Thomson and Rutherford shown in this reproduction of an old print.

(Above) A five-bladed Rotol propeller developed and perfected by English engineers has made possible the handling of extra horsepower in the Spitfire Mark XIV fighter plane. Earlier proposals for five-bladed propellers had met with disdain in many quarters but British tenacity was rewarded with success in this development.

(Below) Two-stage mechanically driven supercharger developed by Rolls-Royce English engineers is shown schematically. The two rotors are mounted on a common shaft. The intercooler serves to reduce the mixture temperature.



(Above) Nazi submarines have suffered through British development of the Leigh searchlight, designed for attachment to Coastal Command aircraft. The light throws a beam of millions of candlepower and has frustrated U-boats in surfacing at night to recharge batteries.

the first radar equipment which was used with such telling effect in the Battle of Britain in 1940; jet-propelled airplanes were flying over British soil in 1941, over a year before such equipment had been developed in America; power-operated turrets were standard before war broke out; the first patent on variable-pitch airplane propellers was taken out twenty years ago by two Englishmen—Dr. Hele Shaw and T. E. Beacham, and developed by H. L. Milner.

Aircraft Engines

In aircraft engines, Britain has in the main favored sleeve-valve engines for air-cooled radial types such as the Bristol Company produce, and servicing has been greatly reduced. These engines have a single thin steel sleeve for each cylinder in place of poppet valves and their attendant operating gear. Totally inclosed, mechanical noise is reduced and they have proved wonderfully reliable and efficient for protracted periods. They power many of the British long-range bombers. The 24-cylinder Napier Sabre liquid-cooled engine of I form also has sleeve valves.

The Rolls-Royce Merlin and Griffon liquid-cooled V-twelve engines of 27 and 36.7 litres respectively have two-stage mechanically driven superchargers which have increased the operational height of British and American aircraft many thousands of feet—to over 40,000 feet in fact. The two rotors are mounted on a common shaft. An intercooler is introduced to reduce the mixture temperature and prevent undue expansion in compressing the large quantity of air.

The entirely new five-bladed propeller developed in England has imported extra speed to high-flying aircraft such as the Spitfire. By reason of the smaller diameter of the blades, tip speed is reduced yet the blade area has been increased.

For a year past a secret searchlight has played a major part in the war against U-boats. Known as the "Leigh Light" the device is of remarkable design, so installed that it will not blind

pilot or crew, but will at the same time throw a beam of millions of candle-power.

U-boats which used to submerge by day and come to the surface to recharge batteries with reasonable security at night, are now safe at no hour of the twenty-four from the special squadrons of the R.A.F. Coastal Command. The technical difficulties in fitting aircraft with powerful and at the same time operationally efficient searchlights were enormous. They were overcome by the Admiralty and R.A.F. in cooperation, and an aircraft was placed at the disposal of Wing Commander N. deV. Leigh after whom the light is named.

Tests proved a huge success and more and more planes were fitted with the device until it is now one of the most powerful auxiliaries to the R.A.F. in its war of attrition against German submarines.

Experiments on Aircraft

In pilotless aircraft controlled by radio from the ground, Britain has carried out many experiments since World War I. The Queen Bee and the Wasp are familiar examples of pilotless craft used in connection therewith, but unrecognizable now is the 32-year-old battleship Centurion which was one of the 50 block ships which crossed the English Channel a day or two before the invasion of Normandy beaches was begun to help set up the prefabricated ports. British ingenuity, skill and labor enabled a quarter of a million men to land on D-Day in the first 24 hours, and one million in the first twenty days, the most imaginative piece of war engineering since Hannibal blasted his way through the Alps. H.M.S. Centurion was once the cork-filled target of the British fleet at battle practice—parent ship of the first pilotless aircraft Queen Bee and Wasp, and the first warship steered by remote radio control.

Some details have recently been released about the equipment carried by the British Airborne Forces in their exploits at Arnheim and elsewhere. One of the enemy's greatest surprises was when his Panzers ran into a screen of anti-tank guns manned by airborne troops and were severely mauled. These anti-tank guns were the British 17-pounder and the 6-pounder, slightly modified for transport by glider. In June, 1940, the need was foreseen for a tank which could be carried in a glider. The "Tetrarch" was, therefore, produced. It weighs less than 10 tons, it can travel at 25 m.p.h. across country, and can climb a slope of 35 degrees. It is armed with a special gun. The Tetrarch's American counterpart is the "Locust." Gliders capable of carrying such heavy tanks were designed, and the Hamilcar was "tailored" from the beginning to fit round the Tetrarch. The Hamilcar and Horsa gliders carry vehicles of all kinds, 75-mm. howitzers, 3-in. mortars, and assault boats and bridging material. At Arnheim these assault boats enabled many men to recross the Lek and reach the Second Army lines.

Production Odds Overcome

Britain has suffered a great deal in five grim years of war, but its spirit never flagged. Early setbacks due to initial unpreparedness served as a stimulus to greater effort. British creative ability was never so pronounced as during this trying and long drawn out conflict. The efficiency of labor grew continuously with the quality of the weapons it produced. Women became skilled in industry. Office workers found new pride in creative work compared to their former hum-drum existence. The length of a working week was less important to them. Some 23,000,000 are either in the armed forces or engaged on vital war work. There are more than 9,000,000 men in the British armed forces, 2,000,000 in the Home Guard, and 500,000 women in uniform. You cannot have it both ways. The insistent call for men for the services at a critical time when Britain stood alone, meant that fewer could be available for industry. Yet production has been phenomenal. Four-fifths of our production of aircraft consist of combat types—a large proportion heavy load carrying bombers which entail many man-hours. Naval construction has been on a massive scale.

Only by scientific research and development can weapons be made efficient. More important even than sheer bravery in the field was the battle being waged in the laboratories and factories. A whole nation working with passionate intensity, and at a time when homes were being blasted and factories rocked by enemy bombs. Superiority in war equipment is not only essential to success, it preserves the lives of our fighting forces.

Sixty-three percent of the munitions supplied to the British armed forces are manufactured in Great Britain; 27 percent are imported from the United States under Lend-Lease; 10 percent are obtained from Canada and the rest of the British Commonwealth.

Apart from that, American forces in Britain have received under reverse Lend-Lease one-third of all their current requirements of military supplies, Mr. Oliver Lyttelton, Minister of Production, has disclosed.

Cooperation in the War

Over 100 airdromes have been constructed for the use of the USAAF at an expense of almost $400,000,000. Camps, workshops, hospitals, repair depots, storage accommodation and essential equipment such as hospital trains and telephone communications have been provided. American troops have been transported across the Atlantic in British ships. Two of the largest and fastest liners in the world, the Queen Mary and the Queen Elizabeth, have been put at the disposal of the U. S. Government under Reverse Lend-Lease.

At least 2,250 aircraft, including 500 gliders and many squadrons of Spitfires have been handed to the United States Army Air Force, as well as quantities of howitzers, anti-aircraft and anti-tank equipment.

Britain has supplied the United States forces in the European theater with one-fifth of their food from supplies grown in the United Kingdom, the Colonies or the Dominion.

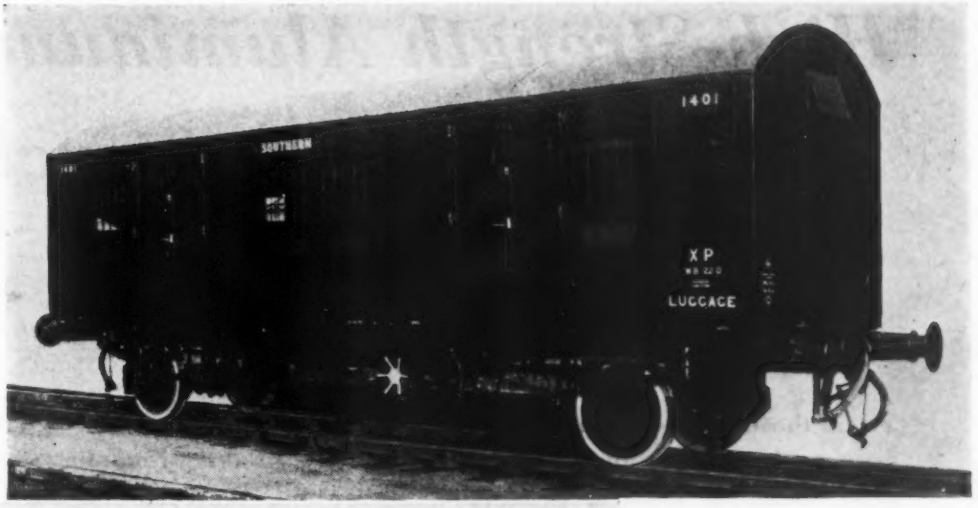
A U. S. Naval base has operated for a full twelve months in Britain without the United States being called upon to make a single cash payment.

Mr. Lyttelton emphasized that Lend-Lease and Reverse Lend-Lease have been key factors in transforming the British Isles into a powerful arsenal and springboard for the invasion of the continent. Without them it would not have been possible to have carried out the great bombing offensive by the British and American air forces, nor to have attempted the great amphibious operations.

Improved Woods

Looking ahead, reinforced multi-plywood of a tensile strength of 27,000 lb. per sq. in. in both directions is being used in several branches of engineering with success. Soft wood is used next to the reinforcing material to provide a superior bond. Even in railway rolling stock the material is likely to be permanently used according to the journal "British Plastics." The Engineering Department of the Southern Railway Company over a year ago assembled probably the first all-plastics van body to be put into service on British railways. It is a ten-ton luggage van, the sides, ends and roof of which are of reinforced laminated paper panels, thereby reducing by 75 percent the weight of the steel panels formerly used. The tare weight of this experimental car is 10 tons, 4 cwt. compared with 13 tons of the existing type.

"Improved" wood is used in the con-



(Right) British experimentation with new materials is demonstrated by this railway car representing probably the first all-plastics van body. The sides, ends and roof are of reinforced laminated paper panels, reducing by 75 percent the weight of the steel panels formerly used in such cars.

(Left) Real engineering ingenuity was demonstrated by English design engineers in developing the Hamilcar Glider, built to carry Tetrarch tanks and other heavy armor in support of airborne operations. The Hamilcar was "tailored" from the beginning of its design to fit round the tank, which weighs more than seven tons. A light tank is shown backing under its own power into a Hamilcar Glider.

struction of the remarkable twin-engined Mosquito which with a crew of two regularly transports two tons of bombs to Berlin.

Radio Telephones on Railway

Experiments with radio telephone apparatus, enabling engine crews and guards of freight trains to converse en route, which were successfully made some months ago by the London and North Eastern Railway, have been carried forward a stage further. During recent tests the chairman of the LNER, sitting in his office at a London terminus, conversed by radio telephone with the chief general manager, who was traveling north on the East Coast main line in a specially equipped train. Reception both ways was very satisfactory, and during the experiment contact was made via three different trunk telephone exchanges of the LNER.

These are but a comparatively few examples of the tremendous amount of research and development work proceeding in the British Isles.

It is often said that the habits, ambitions and activities of a people are largely determined by their tradition. England has had a glorious history of scientific discoveries and inventions. To every Englishman, such names as Newton, Watt, Faraday, Thompson, and Parsons are household words. The ambition of British scientists and engineers is to emulate the accomplishments of her great men of science. This spirit is instilled in all those following the professions of sciences and engineering, just as the traditional spirit of mass production is firmly rooted in the minds of American students of engineering. Lord Kelvin is to the British what Henry Ford or Knudsen is to the American engineers.

Thus we see that there is little conflict between ambitions of the American designers and the activities of the British engineers. The former concentrates on perfecting the basic designs and making them most suitable for mass production. British scientists and engineers put forth their main efforts on new scientific discoveries and product invention. It is true that British engineers have done noteworthy work in perfecting the designs of their products. But this perfection relates mainly to the optimum improvement of the functioning and serviceability of the product rather than the simplification of the design to make it suitable for mass production. British pride in good craftsmanship is inborn not a fetish.

If International relations were such that the efforts of American and British engineers could be made to supplement each other in peace as in war, undoubtedly much more could be accomplished by the English-speaking nations. There will be a great opportunity for bringing such coordinated effort into full effect when the war is over, and technical journals can play an important part. It will simply require that the present intensive cooperation or mutual aid between British and American scientists and engineers be allowed to continue indefinitely undisturbed. Our interests are allied. If this objective can be achieved it will be a contributing factor of great importance to the security of the English-speaking peoples in their peaceful pursuits. It has been said with truth that on the relations of the British Commonwealth and the United States depends the future of civilization.

High-Strength Aluminum Alloys For Lightweight Structures

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To aid those who do not have the time to follow closely the new developments in materials, "super aluminum" alloys in general are discussed with emphasis on possible combinations, practical from a production standpoint, that achieve the best strength-weight ratios for lightweight structures. Alloys and characteristics are compared and evaluated.

A NUMBER of "super-aluminum" alloys have been made available during the past two years, permitting further reductions of weight in design of structures. In general, these alloys have increased ultimate strengths, greatly increased yield strengths and reduced ductility, with a slight increase in density and with no important change in modulus of elasticity.

The improved strength of these alloys, as compared with conventional clad 24ST, are obtained by one of the following methods: Secondary (precipitation) heat-treatment, cold work plus secondary heat-treatment, or change in alloying constituents plus secondary heat-treatment.

Since changes occur in properties, particularly a reduction in ductility, it is important to understand the various effects and their significance with respect to each alloy, so that advantage can be taken of the increased strength-weight ratio with the least increase in manufacturing difficulties.

The four high-strength aluminum base alloys that are now available in commercial quantities divide naturally into two groups: Alloys containing copper as their major alloying constituent and alloys containing zinc as the chief alloying element. The copper group includes the 24-ST80 series of alloys developed at the San Diego Division of Consolidated Vultee Aircraft Corporation and the R301 alloy made by Reynolds Metals Company. The zinc group consists of the 75S alloy of Aluminum Company of America and Reynolds' R303 alloy.

24S-T80 Series of Alloys

The 24S-T80 series of "super-aluminum" alloys is produced by a precipitation (artificial aging) treatment of conventional clad 24S-T, clad 24S-RT and extruded 24S-T, which are nominally alloyed with about 4.5 percent of copper and lesser amounts of magnesium and manganese. The various tempers included in this series and the amounts of cold-work in terms of equivalent percent of tensile set, which are considered necessary to develop the guaranteed minimum mechanical properties after proper processing, are:

24S-T80	0 percent set.
24S-T81 (as received clad 24S-T)	1 percent set
24S-T84	4 percent set.
24S-T86 (clad 24S-RT)	6 percent set

Other properties and pertinent characteristics are contained in Table I.

Until recently extruded 24S was not considered satisfactory for artificial aging. This series of alloys now includes extruded 24S material, though the amount of cold-work and the resultant mechanical properties have not been completely established. In one instance, however, minimum values of 65,000 lb. per sq. in. ultimate tensile strength and 50,000 lb. per sq. in. yield strength have been accepted until consistently higher values can be obtained.

The hardening process for all 24S material consists of a solution heat-treatment at 910 to 930 deg. F. followed by a cold water quench. Precipitation heat-treatment to obtain maximum mechanical properties can be accomplished by many different time-temperature cycles, the time at temperature depending upon the temperature and the amount of previous cold-work. The recommended secondary heat-treatment is 6½ hr. at 375 deg. F. for all tempers. This appears to be the best compromise of all the factors affecting the aging of the several tempers of 24S aluminum alloy. This material is not affected by prolonged exposure to temperatures up to 300 deg. F. At higher temperatures, however, time at temperature becomes increasingly critical (overaging), and aging cycles at temperatures above 375 deg. F. are not considered practical.

In considering the mechanical properties of aged 24S alloys, it should be noted that cold-work alone tends to increase the tensile yield and ultimate of 24S-T (as received), 24-RT and 24S-RT. However, when a precipitation treatment is superimposed on the cold-work, as in the case of 24S-T81, 24S-T84, and 24S-T86, the compressive yield is greatly increased and tensile properties are increased to a lesser extent. Because of their lower properties, 24S-T81 and 24S-T80 are used only where better forming characteristics are required. From a strength standpoint, there is little gained by aging thin sheet material. Since 24S-T86 material has low impact and ductibility, it is believed inadvisable to artificially age 24S-RT sheet stock 0.032 in. and thinner to the "T86" condition.

In the annealed condition clad 24S material is readily formed. However, since most tempers of 24S aged alloys require cold-work after solution heat-treatment, any forming to be done on 24S-T81, 24S-T84 and 24S-T86 must usually follow heat-treat and cold-work operations. Since aging these cold-worked materials considerably reduces ductibility and raises yield strength, it is almost mandatory to do all forming before precipitation treatment. Since the materials used to produce 24S-T81, 24S-T84, and 24S-T86 have only fair formability immediately prior to the aging operation (T or RT condition), their use should be restricted to

Table I — Guaranteed Properties of Several High-Strength Aluminum Base Alloys

Material	Aging Cycle (1) (Recommended) Temp., Deg. F.	Aging Cycle (1) (Recommended) Time, hr.	Properties Depend on Cold-Work	Mechanical Properties (1,000's lb. per sq. in.) Compression Yield	Tensile Yield	Ultimate	Elong., percent	Fatigue Strength Compared to 24S-T	Impact Strength Compared to 24S-T	Spot Welding Weldability (6)	Spot Welding Shear Compared to 24S-T	Forming Characteristics Bend Radii (2)	Joggling(6)	Dimpling(6)	General(6) Forming	Finish Requirements
Clad 24S-O			No	10	10	27	12.0	Lower	Higher	G	Lower	0	E	E	E	None
Clad 24S-O, H.T.			No	38	38	60	11.0			G		3t	G	G	G	"
Clad 24S-T80	375±5	6½±¼	No	49	49	62	8.0	Higher	Sl.Lower	G	Higher	4t	F	F	P	" (4)
Clad 24S-T (As Rec'd)			Yes	42	42	64	11.0			G		3t	G	G	G	None
Clad 24S-T81	375±5	6½±¼	Yes	59	59	67	5.0	Higher	Sl.Lower	G	Higher	4t	P	P	P	" (4)
Clad 24S-O, H.T. 4% Stretch			Yes	42	52	65	10.0	Sl.Higher	Sl.Lower	G	Same	4t	F	F	F	None
Clad 24S-T84	375±5	6½±¼	Yes	66	66	70	5.0	Higher	Lower	G	Higher	5t	VP	VP	VP	" (4)
Clad 24S-RT (As Rec'd)			Yes	53	53	68	8.0	Sl.Higher	Sl.Lower	G	Same	4t	P	F	F	None
Clad 24S-T86	375±5	6½±¼	Yes	69	69	72	4.0	Higher	Lower	G	Higher	6t	VP	VP	VP	" (4)
Clad R301-O			No		10	27	16.0	Lower	Higher	G	Lower	0	E	E	E	None
Clad R301-W			No		37	57	15.0	Same	Same	E	Same	3t	G	G	G	"
Clad R301-T (3)	350±5	6	No		57	64	8.0	Higher	Sl.Lower	E	Higher	4t	P	P	P	"
Clad R303-O			No		10	30	10.0	Lower	Higher			1t	E	E	E	None
Clad R303-T	275±5	25	No		64	70	7.0	Higher	Lower			5t	VP	VP	VP	"
Extruded R303-O			No		12	33	12.0	Lower	Higher			1t	G	G	E	Anodize & Prime
Extruded R303-T	275±5	25	No		70	75	7.0	Higher	Lower			6t	VP	VP	VP	"
Clad 75S-O			No		12	32	10.0	Lower	Higher	G	Lower	1t	E	E	E	None
Clad 75S-W			No	42	40	68	10.0	Sl.Higher	Sl.Lower	E	Higher	2t	G	G	G	"
Clad 75S-T (5)	250±5	24	No		64	74	8.0	Higher	Lower	E	Higher	5t	VP	VP	VP	"
Extruded 75S-O			No		12	33	12.0	Lower	Higher			1t	E	E	E	Anodize & Prime
Extruded 75S-W			No		45	75	12.0	Sl.Higher	Sl.Lower			3t	G	G	G	"
Extruded 75S-T	250±5	24	No		70	78	8.0	Higher	Lower			6t	VP	VP	VP	"

(1) Aging cycle required to attain indicated tempers.
(2) Approximate minimum bend radii for material 0.064 to 0.102 in. thick.
(3) Material purchased as R301-O and subsequently solution heat-treated and aged has 54,000 lb. per sq. in. tensile yield, 62,000 lb. per sq. in. tensile ultimate and 8 percent elongation.
(4) Army requires edges be primed.
(5) Material purchased as 75S-O and subsequently solution heat-treated and aged has 62,000 lb. per sq. in. tensile yield, 72,000 lb. per sq. in. tensile ultimate and 8 percent elongation.
(6) Letters E, G, F, P, and VP stand for excellent, good, fair, poor and very poor respectively.

applications requiring relatively flat or straight sections.

The Izod impact strength of the aged tempers of 24S appears to be approximately 50 percent of the impact strength of conventional 24S-T material. For example, 24S-T bar stock was found to have Izod impact values of 10 to 12 ft. lb., while aged 24S-T bar stock had Izod impact values of 4 to 6 ft. lb. only. Material stretched to 4 percent and 6 percent permanent set, then tested for Izod strength, was found to have impact values approximately the same as those for aged and unaged material.

Fatigue data on these alloys are rather meager. A few recently completed tests indicate that fatigue strengths are approximately the same for aged and unaged materials. In spite of these limited tests, and provided of course previous trends in fatigue strengths of aluminum base alloys are valid, it is believed that the aged tempers of 24S aluminum alloys, because of their high yield and tensile strength, have fatigue strengths exceeding those of unaged 24S-T material.

Fabricating Qualities

Spot welding tests indicate that aged 24S in all tempers can be spot welded satisfactorily. Shear strengths of spot welds obtained in the aged material were appreciably higher and more consistent than the values obtained on unaged spot welded shear specimens. This was true with specimens that were spot welded after aging as well as with specimens that were spot welded prior to aging.

The minimum bend radii, shown in Table I, indicate that the aged tempers of 24S must be bent to more generous radii than unaged 24S-T material. Furthermore, all types of forming, such as joggling, dimpling and drawing, can be done more easily on unaged 24S materials than on the 24S-T80 series of alloys. However, it is possible to increase the formability of aged 24S alloys by forming at or near 375 deg. F., the aging temperature. The mechanical properties of aged materials are not affected by a short period at this temperature.

Corrosion resistance of the several tempers of aged 24S aluminum alloy is satisfactory when aged at the recommended, or equivalent time-temperature cycle. A decrease in aging time to less than the 6½ hr. recommended for the 375 deg. F. aging cycle, though resulting in only a slight loss in mechanical properties, is not recommended because corrosion resistance is adversely affected.

In general, none of the aged tempers of clad 24S require prime or paint finishes. Sometimes, however, sheared and cut edges have had to be primed or

given some other approved finish. Aged 24S extrusions are anodized and primed according to standard practice.

Clad R301 Alloy

Core material of clad R301 is similar in composition to Alcoa's 14S alloy and the cladding is similar to Alcoa's 61S, which varies in thickness from 8 percent per side on thin material to 2 percent per side on material more than 0.102 in. thick. The nominal analysis for R301 core is 4.5 percent copper with small amounts of silicon, manganese, and magnesium. The cladding contains approximately 1 percent magnesium, ½ percent silicon and manganese, and balance aluminum.

This alloy is available in sheet and plate form only. The only real distinction between this alloy and 14S is the cladded surfaces. Extrusions and forgings cannot be made in the cladded form.

The hardening operation for R301 alloy consists of a solution heat-treatment at 940 deg. ± 10 deg. F. followed by a precipitation heat-treatment at 350 deg. ± 5 deg. F. for 6 hr. Other combinations of time and temperature can be used to accomplish the precipitation (aging) treatment provided the material after aging conforms to specification requirements. An aging cycle of 375 deg. F. for 6½ hr. tends to overage R301-W slightly: but mechanical properties should still be satisfactory. Cold-work, such as stretching or rolling, which is accomplished before aging but after solution heat-treatment, has no appreciable effect on the aging characteristics of this alloy.

The mechanical properties of the "T" temper of R301 are quite high, and efficient designs can be made using this high-strength alloy. This is particularly true of parts that must be formed from fully annealed material. Although there are no values shown in Table I for the compressive properties of the several tempers of R301, it is believed that the compressive yield strength will always be approximately the same as the tensile yield strength reported for the respective tempers.

Many parts can be formed from the "W" temper of R301 and then aged to the "T" temper by the 350-deg. F. aging treatment which, incidentally, causes no distortion. Forming in the "W" temper avoids the extremely undesirable warpage that always occurs in solution heat-treatment.

The Izod impact strength of R301 varies inversely with the tensile strength; that is, in the annealed condition, it has a much higher Izod impact value than in the "T" temper. In general, aluminum alloys are notch-sensitive and the aging operation apparently tends to aggravate this condition.

Fatigue data on this alloy are also meager, but it can be reasonably assumed that fatigue characteristics in the "T" temper are comparable to those of clad 24S-T81, which are satisfactory. The fatigue limit, when it is finally established for R301-T, will probably be in the neighborhood of 20,000 lb. per sq. inch.

Spot welding characteristics of R301-T appear to be excellent. Recent tests indicate that the shear strength of R301-T is higher and more consistent than that of clad 24S-T. Since there are no allowable shear values for this new material, it will no doubt be satisfactory to use values approved for clad 24-ST material.

The minimum bend radii for the various tempers of R301 indicate that the material in the annealed condition can be bent through 90 deg. with little or no radius. In the "W" and "T" temper, however, it is necessary to have radii approximately equivalent to those used with clad 24S-T. Types of forming, such as dimpling, joggling and drawing can be done with certain exceptions in the "W" condition. In the "T" temper, the general forming characteristics are not satisfactory, but can be improved by forming hot (350 deg. F.). The short times, 10 to 30 minutes, required for hot forming R301-T are not detrimental to mechanical properties.

Corrosion resistance of clad R301 material is generally acceptable to the Army and Navy. However, this material should not be used in the annealed condition because its core would be susceptible to corrosion. Cladding gives adequate corrosion protection and can be used without prime or paint coatings if the color is satisfactory.

75S Aluminum Alloy

The 75S aluminum base alloy is among the newer types of alloys that contain zinc as the major alloying constituent instead of copper, which characterizes the older duralumin type alloys. Nominally 75S alloy contains about 6 percent zinc and lesser amounts of copper, magnesium, and manganese. The alloy weighs about 0.102 lb. per cu. in., approximately 2 percent more than the 24S alloy. It is available in the form of clad sheet, bare sheet, extrusions and, at some later date, forgings. The cladding consists of a 1 percent zinc-aluminum alloy and each surface has approximately 4 percent of cladding.

The hardening operation for the 75S alloy consists of a solution heat-treatment and a precipitation treatment. The temperature for solution heat-treatment that appears to be most practicable from the standpoint of production and resultant mechanical properties, is 920 ± 10 deg. F. for sheet material and approximately 860 ± 10 deg. F. for extrusions and forgings. The soaking time at the solution heat-treat temperature varies, of course, with the thickness of the section. Sheet stock should remain at temperature 20 to 30 min. while extrusions and forgings should be at temperature from 30 to 60 min. The aging treatment for all shapes of 75S should be 250S ± 5 deg. F. for 24 hr. approximately.

The properties of 75S-W, although not reported by the specifications, are shown in Table I because it is probable that a large amount of forming can be accomplished on this alloy in the "W" temper. The mechanical properties in the "T" temper, particularly in extrusions, are high. If properly used in designs, these high properties can be translated into strong, lightweight structures having high strength-weight ratios.

Stretching, or cold-work of any kind, performed on this material prior to aging, has no beneficial effect; in fact, tests indicate that material stretched 2 percent or more before aging has lower tensile and compressive yield values after aging than the unstretched and aged material. Any forming done on this material while in the "W" temper, however, would not usually be sufficient to affect seriously the mechanical properties of the final product.

In the annealed condition 75S alloy can be safely bent through 90 deg. with a radius of only 1t. In the "T" temper the bend radius should be rather large, although this is not too desirable for most parts. In the "W" temper, however, the minimum bend radius should be only 2t to 3t, depending upon the form, but this no doubt is sufficient to warrant forming many aircraft parts in the "W" temper. In addition, severe forming can be done on 75S-W immediately following and up to about 10 hr. after quenching, which will undoubtedly permit the manufacture of additional parts in the 75S-W condition. Forming in the "W" temper is desirable from the shop standpoint because it eliminates all rework caused by warpage in detail parts during solution heat-treatment.

Joggling, dimpling, and other forming operations can be performed on 75S-T if special care and equipment are used. From a production standpoint, it is more desirable to perform these operations when the material is in the "W" temper. Hot-forming of 75S-T alloys is satisfactory because heating at 250 deg. F. (aging tempera-

ture) apparently increases the formability appreciably.

Izod impact values for the various tempers of 75S are not known, but it is probable that the impact characteristics are similar to those of the other high-strength alloys. Fatigue data on this alloy are also meager. It is safe to assume that the fatigue limit, when established for 75S-T, will be as high or higher than that of clad 24S-T material.

Both 75S-T and 75S-W (subsequently aged) can be spot welded readily. Shear strength of spot welds was found to be higher and the values more consistent than spot welds on clad 24S-T. Shear strength allowables for the various combinations of thicknesses will be established for clad 75S-T in the near future.

Corrosion resistance of clad 75S-T is excellent. Even the unanodized and unprimed base sheet and extrusions are reported to have good corrosion resistance. However, it seems advisable to apply standard anodic and primer finishes to bare sheet and extrusions. Clad sheet is serviceable without primer or paint finish.

R303 Aluminum Alloy

The high strength R303 alloy, like 75S material, contains zinc as the major alloying element. In addition to approximately 7 percent zinc, this alloy contains minor amounts of copper and magnesium, and traces of manganese and chromium. This alloy weighs approximately 0.102 lb. per cu. in. or about 2 percent more than the currently used 24S alloy. R303 is now available only in the extruded form. Both bare and clad sheet stock are expected to become available in the immediate future.

The recommended hardening operation for R303 alloy is a solution heat-treatment at 825 ± 10 deg. F. followed by a precipitation heat-treatment of 275 deg. F. for 25 hr. or 315 deg. F. for 8 hr. The soaking time at 825 deg. F. should be from 20 to 60 min. depending on thickness. Recently completed tests indicate that the best mechanical properties are obtained with a precipitation heat-treat temperature of 265 to 275 deg. F. and that satisfactory properties can be obtained with temperatures between 250 and 275 deg. F., and with time at temperature between 16 and 20 hours.

The mechanical properties of R303 alloy in both the annealed and hardened conditions are the tentative guaranteed properties for material aged at 275 deg. F. for 25 hr. Compression properties have not been completely established, but meager test data indicate that the mechanical properties will permit designs with high strength-weight ratio.

Formability of this alloy by bending, joggling, dimpling, and drawing is excellent in the annealed condition, but extremely poor in the "T" temper. Heating to the aging temperature and forming hot do not improve the formability of this alloy. Formability in the quenched condition ("W" temper) is good. Up to 10 hr. after quenching, it is only slightly more difficult to form than annealed R303 alloy.

Fatigue and impact data on this alloy are not known but are believed to be comparable to the fatigue and impact properties of 75S aluminum alloy.

Corrosion resistance of R303 alloy in the extruded form is satisfactory. Reynolds Metals Company reports that both the bare and clad sheet have good corrosion resistance. It is necessary, however, to anodize and prime extruded stock and bare sheet.

Miscellaneous Materials

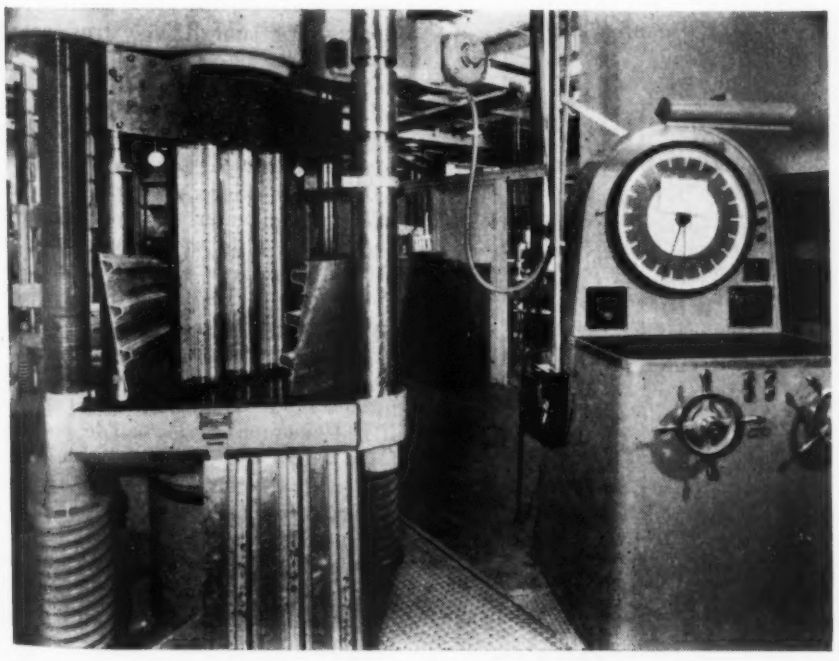
Approval was recently granted to age at 375 deg. F. for 6½ hr. several other aluminum alloys: 14S, A17S, 17S, 195 and 356. These materials should not be aged at this time-temperature cycle for the express purpose of increasing their mechanical properties but are aged because they are, of necessity, parts of assemblies that receive an aging treatment. The 14S material in the "W" temper, however, would be so aged to obtain the "T" temper, when included in an assembly aging operation.

In general, the mechanical properties of these alloys when aged at 375 deg. F. for 6½ hr. are slightly lower than their maximum properties. However, it is expected that they will all meet their respective minimum specification properties after such treatment. When using these alloys in assemblies that are to be aged at 375 deg. F., the following conditions should be used as far as is practicable: (1) 14S in the "W" tempers; (2) 195 and 356 in the "T4" temper; and (3) A17S and 17S in the "T" temper.

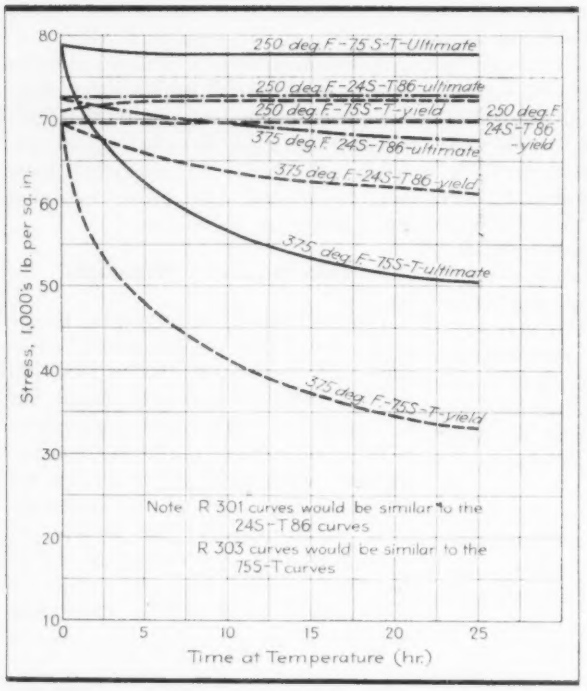
It is believed that the alloys mentioned above will also be used in conjunction with assembly aging of 75S and R303 and, as such, will be aged at 250 or 275 deg. F. for 24 hr. The mechanical properties of these alloys should not be appreciably affected by an aging treatment of 250 or 275 deg. F. for 24 hr.; therefore they should be properly aged prior to their aging as part of an assembly.

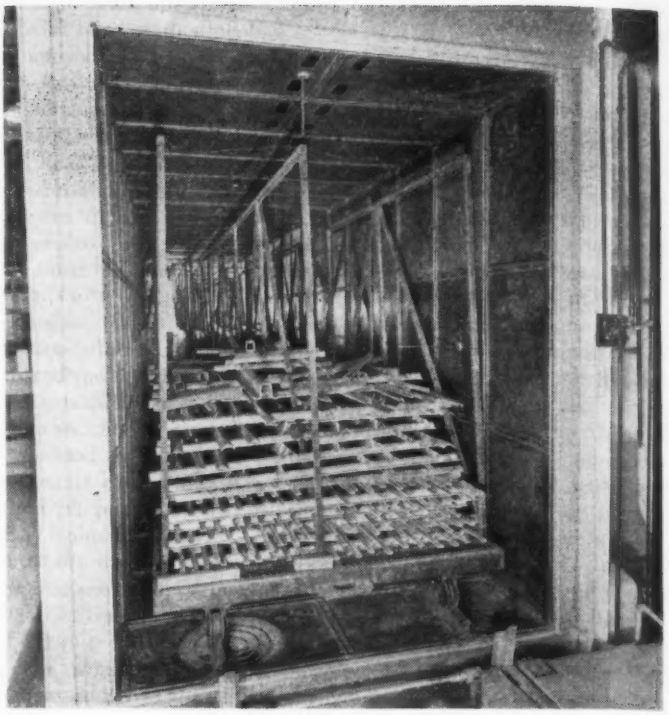
Fabricating Limitations

Since all high-strength aluminum alloys require a solution and a precipitation heat-treatment, there is no advantage so far as the number of operations is concerned. The type of equipment required for these operations is identical, because the temperatures used are in the same range for all alloys. The aging time, however, varies and might give an advantage to certain ones of the high-strength alloys. In general, the duralumin-type alloys (24S-T80 series and R301) can be aged at 350 to 375 deg. F. for 6 to 7 hr. while the zinc-bearing alloys (75S and R303) require approximately 24 hr. at



Aluminum alloy panels are tested on a 400,000-lb. hydraulic test machine.





(Left) Effect of heat for various lengths of time at two temperatures on the tensile properties of properly aged 75S-T and 24S-T86 aluminum alloys. (Right) Large air furnace used for the artificial aging of high-strength aluminum alloys.

Table II — Cost Comparison Of Roll-Formed and Extruded Sections

Rolled Sections				Equivalent Extruded Section		Ratio (1) Cost of Shapes to Extrusions	Ratio (2) Cost of Shapes to Extrusions
Type of Section	Area	Vendor's Price per ft.	Estimated Cost per ft.	Area	Vendor's Price per ft.		
Angle	0.0420	0.055	0.05	0.042	0.0447	1.23	1.11
"	0.0573	0.07	0.06	0.059	0.0507	1.38	1.18
"	0.0859	0.075	0.08	0.087	0.0655	1.14	1.22
"	0.01191	0.15	0.09	0.133	0.08	1.87	1.12
"	0.1348	0.16	0.10	0.121	0.1208	1.32	0.83
"	0.1859	0.20	0.12	0.180	0.1409	1.42	0.85
"	0.2897	0.27	0.20	0.230	0.1478	1.82	1.35
"	0.0728	0.15	0.07	0.067	0.0497	3.10	1.40
"	0.1897	.....	0.08	0.157	0.0907	.....	0.88
"	0.1646	.....	0.12	0.1786	0.110	.....	1.09
"	0.2101	.....	0.14	0.226	0.1292	.....	1.08
"	0.3134	.....	0.20	0.320	0.1990	.....	1.01
"	0.4850	.....	0.40	0.485	0.284	.....	1.41
Channel	0.1226	0.11	0.10	0.136	0.097	1.13	1.03
"	0.2343	.....	0.12	0.231	0.1495	.....	0.80
"	0.4977	.....	0.31	0.493	0.1495	.....	1.05
"	0.1977	.....	1.18		1.059	.....	1.11
Hat	0.4454	.....	0.42	0.449	0.2979	.....	1.41
"	0. 4978	.....	0.33	0.491	0.3306	.....	1.00
"	0.637	0.586	0.38	0.676	0.2217	2.62	1.71
Zee	0.1094	.....	0.10	0.113	0.0947	.....	1.05
"	0.0629	.....	0.08	0.059	0.0750	.....	1.06
"	0.2107	0.19	0.17	0.223	0.150	1.27	1.13
"	0.1492	.....	0.13	0.130	0.167	.....	0.78
"	0.1430	.....	0.13	0.134	0.1057	.....	1.23
"	0.2342	.....	0.20	0.224	0.202	.....	1.00
					Average	1.66	1.11

(1) Ratio of cost of roll-formed shapes purchased from vendor's to cost of extrusions.

(2) Ratio of cost of roll-formed shapes made by Consolidated Vultee to cost of extrusions.

250 to 275 deg. F. At the rate of production possible with three shifts of workmen, it is advantageous to design with the super-duralumin alloys and thus use the aging furnace equipment to the best advantage by treating three loads of parts each 24 hr. With one shift of workers it would be possible to treat one lot of parts only, each 24 hr. whether the parts require a 6½ or a 23½-hr. aging cycle.

If extrusions instead of roll-formed sections can be used as stiffeners and flanges, 75S and R303 extrusions are desirable because of the high mechanical properties of these alloys in this form. Furthermore, extrusions have the following advantages over the roll-formed sections:

1. The section properties of extrusions are better than rolled shapes because there is more material at the corners and large portions of the sections can be located at desired distances from the neutral axis.

2. The cost of extrusions averages 11 percent cheaper than comparable roll-formed sections, as shown in Table II. If the comparison is made on roll-formed sections purchased from vendors, the differential is as high as 66 percent. Extrusions, of course, must be anodized and primed, while roll-formed shapes made from clad material do not require any finish. Another consideration, serious perhaps only in an emergency, and which tends to offset the generally higher costs of the rolled shapes, is the greater freedom from de-

Table III — Effect of Several Aging Cycles on Mechanical Properties of Various High-Strength Aluminum Alloys

Material	(1) Aged at 375 deg. F. for 6-½ hr.			(2) Aged at 350 deg. F. for 6 hr.			(3) Aged at 275 deg. F. for 25 hr.			(4) Aged at 275 deg. F. for 12 hr.			(5) Aged at 250 deg. F. for 24 hr.		
	Tension			Tension			Tension			Tension			Tension		
	Ultimate Strength 1000's lb. per sq.in.	Yield Strength 1000's lb. per sq.in.	Elongation percent	Ultimate Strength 1000's lb. per sq.in.	Yield Strength 1000's lb. per sq.in.	Elongation percent	Ultimate Strength 1000's lb. per sq.in.	Yield Strength 1000's lb. per sq.in.	Elongation percent	Ultimate Strength 1000's lb. per sq.in.	Yield Strength 1000's lb. per sq.in.	Elongation percent	Ultimate Strength 1000's lb. per sq.in.	Yield Strength 1000's lb. per sq.in.	Elongation percent
Clad 24S-O Heat-Treated to 24S-T	62	49	8.0	62	43	11.0	60	38	11.0	60	38	11.0	60	38	11.0
Clad 24S-T80 (8)	61	49	8.0	62	49	8.0	62	49	8.0	62	49	8.0	62	49	8.0
As-Received Clad 24S-T	67	59	5.0	65*	55*	5.0	64	42	11.0	64	42	11.0	64	42	11.0
Clad 24S-T81 (8)	65	57	5.0	67	59	5.0	67	59	5.0	67	59	5.0	67	59	5.0
Clad 24S-O Heat-Treated and Stretched 4%	70	66	5.0	66	61	5.0	65	52	10.0	65	52	10.0	65	52	8.0
Clad 24S-T84 (8)	66	60	5.0	69	65	5.0	70	66	5.0	70	66	5.0	70	66	4.0
As-Received Clad 24S-RT	72	69	4.0	70	67	4.0	68	53	8.0	68	53	8.0	68	53	8.0
Clad 24S-T86 (8)	68	63	4.0	71	68	4.0	72	69	4.0	72	69	4.0	72	69	4.0
Clad R301-W	64	57	8.0	64	57	8.0	59*	39*	16.0	59*	39*	16.0	59*	39*	16.0
Clad R301-T (8)	62	54	8.0	63	55	8.0	64*	57*	8.0	64*	57*	8.0	64*	57*	8.0
Clad R303-W	61*	46*	7.0	63*	58*	7.0	70	64	7.0						
Clad R303-T (8)	61*	46*	7.0	61*	56*	7.0	68*	62*	7.0						
Extruded R303-W	58*	44*	7.0	65*	60*	7.0	75	70	7.0						
Extruded R303-T (8)	56*	42*	7.0	63*	58*	7.0	73*	68*	7.0						
Clad 75S-W	61	46	8.0	66*	53*	8.0	72(6)	62(6)	8.0	72(6)	62(6)	8.0	72	62	8.0
Clad 75S-T (8)	61	46	8.0	64*	50*	8.0	72	62	8.0	72	62	8.0	72	62	8.0
Extruded 75S-W	58	44	6.0	68*	55*	6.0	78*	70*	6.0	78*	70*	6.0	78	70	6.0
Extruded 75-S-T (8)	56*	42*	6.0	66*	53*	6.0	76*	67*	6.0	78*	70*	6.0	74	64	6.0

*Properties are estimated from available data at other aging times and temperatures.
(1) Recommended aging cycle for 24S alloys.
(2) Recommended aging cycle for R301 alloys.
(3) Recommended aging cycle for R303 alloys.
(4) Alternated aging cycle for 75S alloys.
(5) Recommended aging cycle for 75S alloys.
All values shown above for 24S alloys are for material more than 0.065 in. thick to Specification AN-A-13.
(6) From Aluminum company data (C.V.A.C. data indicate that lower properties are attained at 275 deg. F. – aging).
(8) These materials have been properly aged before treatment shown in Columns 1 to 5.

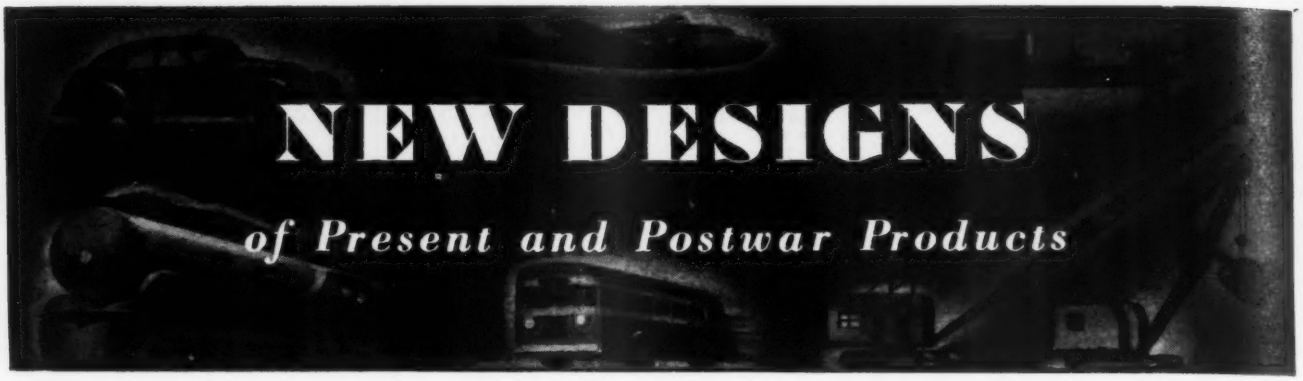
lays in deliveries when the shop is not dependent upon the extrusion mills. The use of rolled shapes, rather than extrusions, is considered to have contributed appreciably to the production record made with the B-24 series airplanes.

Both the 250 and 375 deg. F. aging treatments tend to bake zinc chromate primer and paints. In general, baking increases the adhesion and abrasion resistance of these coatings, but it is reported that the coatings are made somewhat brittle. If assembly aging is used for airplane wing panels, it is necessary for integral tank sealing materials to withstand the temperature of the aging cycle used. At present an investigation is in progress to determine how well fuel tank sealing materials withstand recommended aging cycles for the various super-aluminum alloys. In general, most of them decompose at the 350 to 375 deg. F. aging cycles. Although the tests are not yet completed, it is evident that they do not decompose appreciably at 250 deg. F. This may mean that it will be possible to assembly-age 75S and R303 structures with integral tanks that were gas tightened during fabrication.

In making efficient airplane structures from the new high-strength aluminum alloys, it must be known whether or not the parts are to be artificially aged as detail parts or as assemblies. This can be more clearly understood by studying Table III. The data in this table indicate that if the parts are to be aged as assemblies, the designs should, in general, consist of the 24S-T80 series of alloys and R301, or of 75S and R303 because zinc-bearing alloys are overaged at 375 deg. and copper-bearing alloys are not affected at 250 deg.

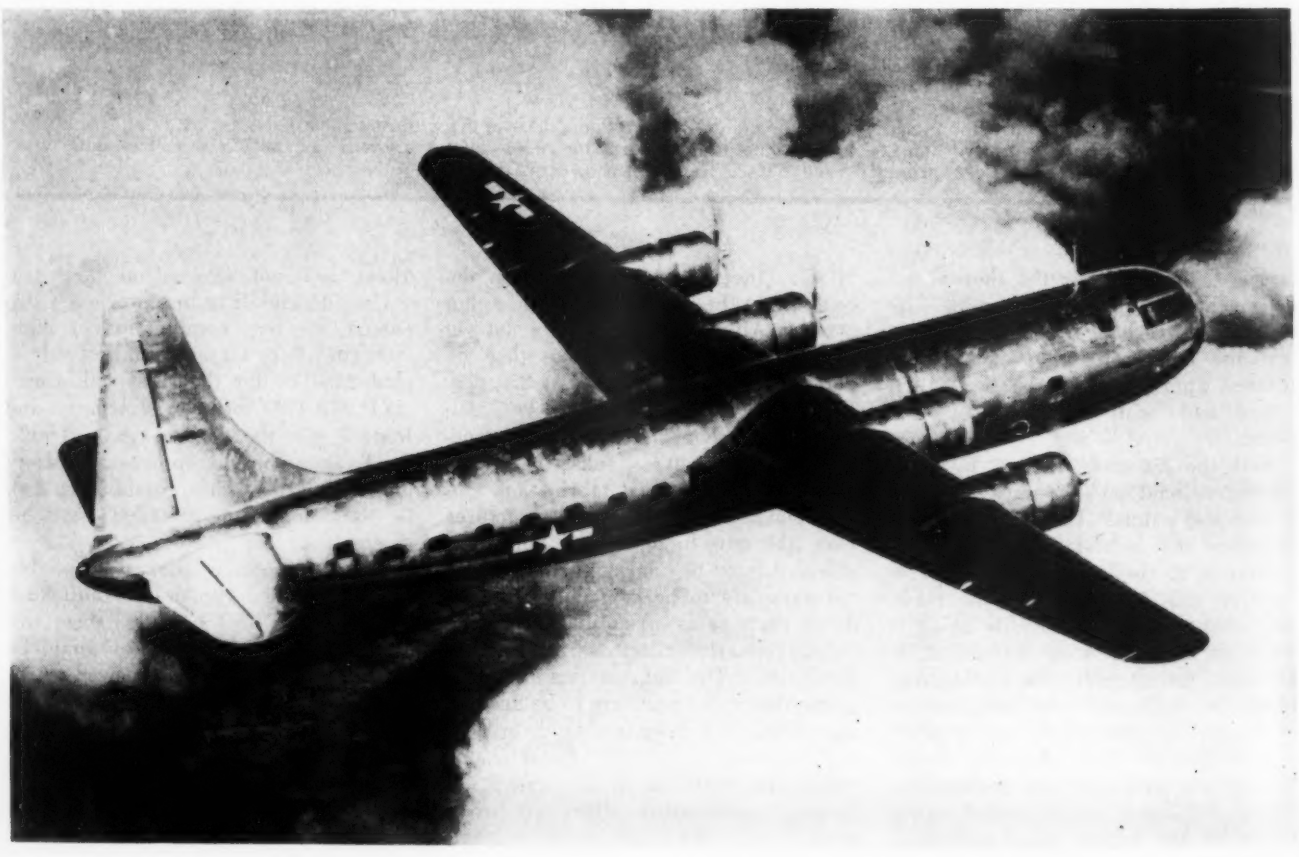
Considering all factors previously discussed, the best combination of high-strength alloys for aircraft probably is clad 24S-T86 for the skin, roll-formed clad 24S-T84 for the stiffeners, and R301-T for the formed parts (bulkheads and other hydropress and drop-hammer parts). This combination can be used for aging detailed parts or assemblies.

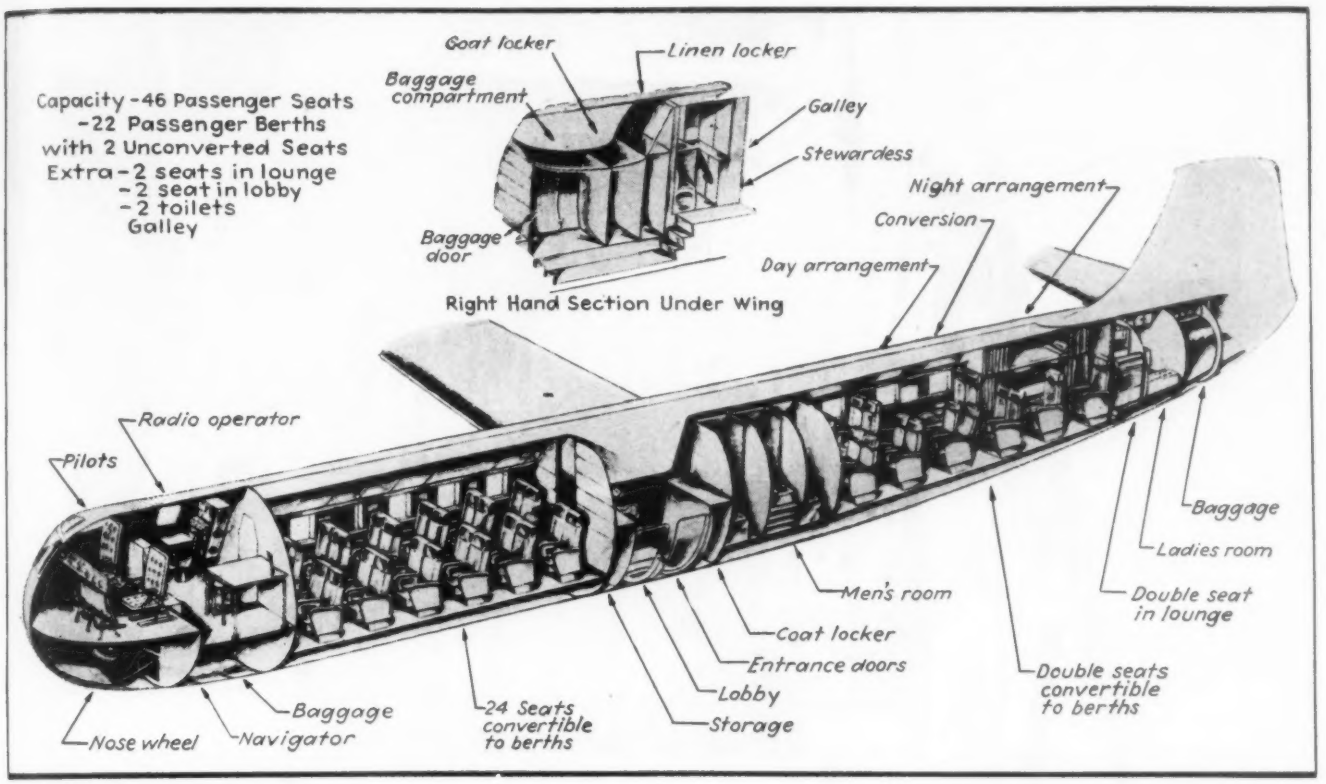
The combination that is probably most desirable in postwar manufacture of aircraft is 75S-T or R-303 sheet and extrusions. As-received sheet would be used for the covering, as-received extrusions for the stiffeners, and sheet in the "O" or "W" condition, with subsequent heat-treatment to yield the "T" condition, for formed parts. Such a combination would be adaptable both for detail and assembly aging.



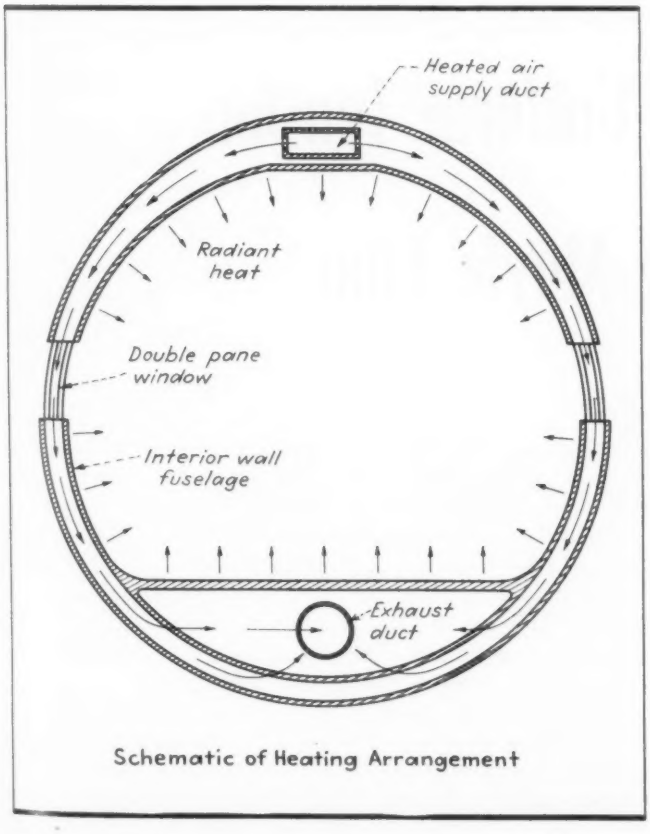
Engineering Advances in Military Plane Utilized in New Postwar Airliner

MANY features of the famous B-24 Liberator are incorporated in the Consolidated-Vultee Model 39 Airliner. Aim of the engineers was to combine refinements of production military planes with a fuselage adaptable to commercial purposes. Hence the plane has the Davis high-left wing, the B-24 powerplant and langing-gear arrangement and a newly developed heating and ventilating system. An additional advantage of the design is that existing production facilities can be used. The plane can carry 25,000 lb. useful load.





Fuselage of the plane, 90 ft. long, contains a flight deck in the nose for a crew of five. The arrangement aft depends on whether the plane is used for cargo or passenger service. The sketch shows the arrangement for passenger transportation, as developed by Henry Dreyfuss. Seats of special design are equipped with individual reading lights and pillow radios. Four basic arrangements are available for the interior: Coach, lounge, convertible and pullman. Several can be combined, if desired. Drawing shows typical day arrangement and conversion to night accommodation.

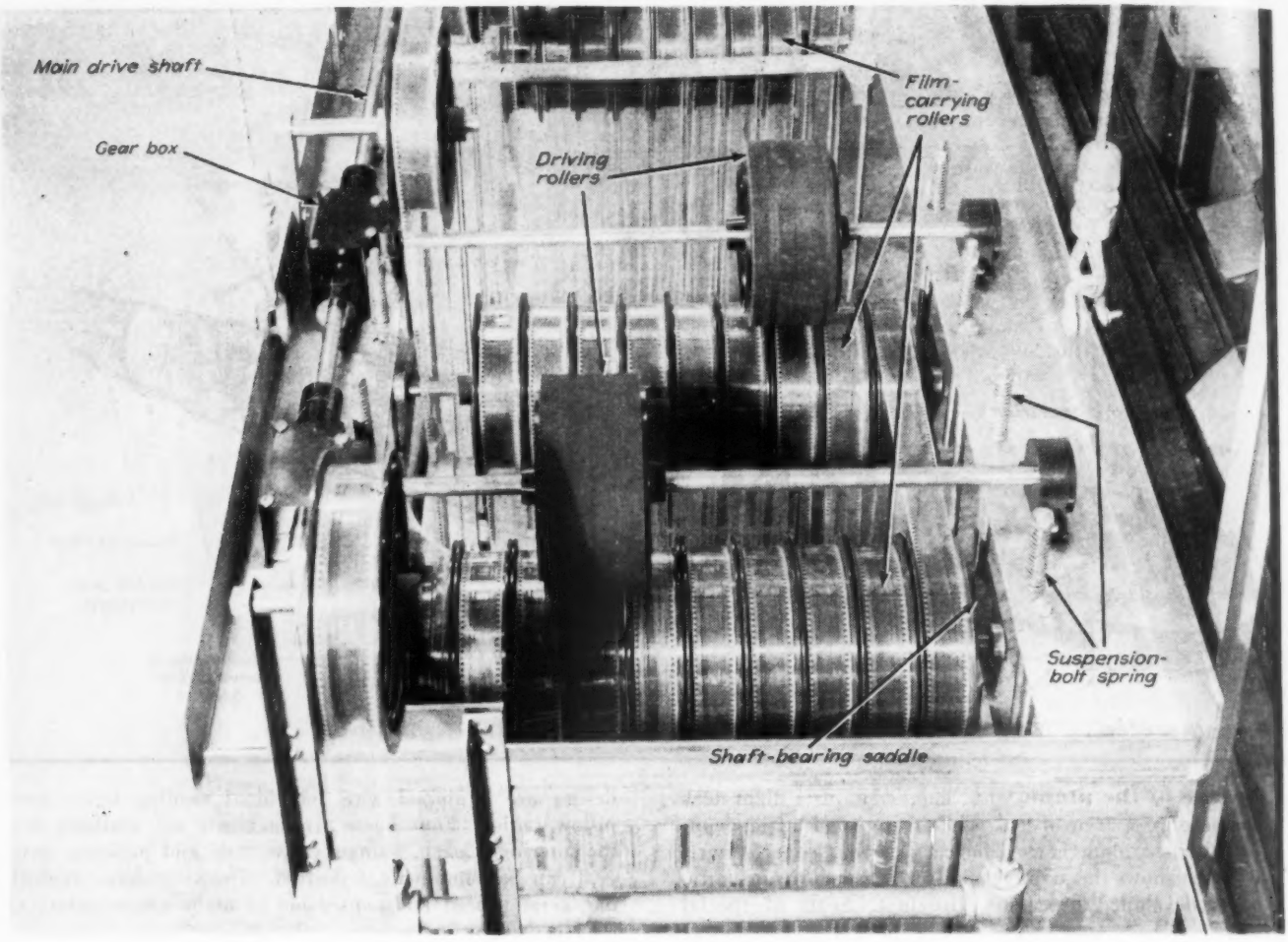


Schematic of Heating Arrangement

Radiant wall-heating replaces the usual hot-air system. In conventional planes, heat losses are made up by introducing heated air which also serves ventilation purposes into the cabin. In the radiant system on the Model 39, hot air is supplied by a ceiling duct running the entire length of the cabin. The fuselage has a continuous airspace through which the hot air circulates, heating the ceiling, walls and floor. The air is exhausted through a duct running beneath the floor. Walls are maintained at a temperature of 100 deg. F. Warm air also circulates in the space between the double windows. Ventilation is supplied by a separate duct inside the heated air-supply duct. Both ducts are tapered toward the rear and are led into the empennage where the remaining heat is used for anti-icing. The ram pressure driving the air through heaters and ducts is aided by tail-end suction.

Windshield is of double-pane construction through which warm air is forced by blowers. Warm air also prevents icing on the wings. It is piped through D-shaped ducts in the leading edges. Openings in the duct allow the heated air to escape into the wing. It is discharged at the trailing edge in the outer panels and through the top and over the wing in the center panels.

One heat exchanger is installed in the exhaust of each engine. Output of each heater is 185,000 B. t. u. per hr. at cruising speed, 265,000 B. t. u. per hr. maximum. The heat from the outboard heaters is used for wing anti-icing; the heat from the inboard heaters is used for cabin heating. Entire system is fully automatic, compensating for varying density of air. Under heavy icing conditions one inboard heat exchanger can be switched over to wing anti-icing.

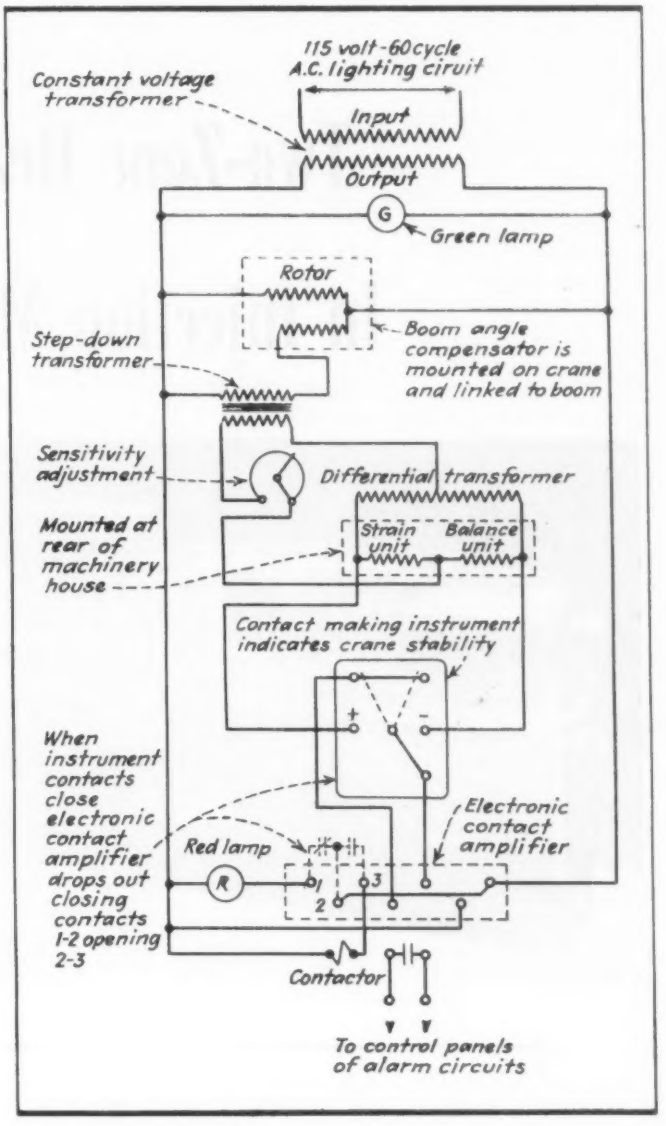


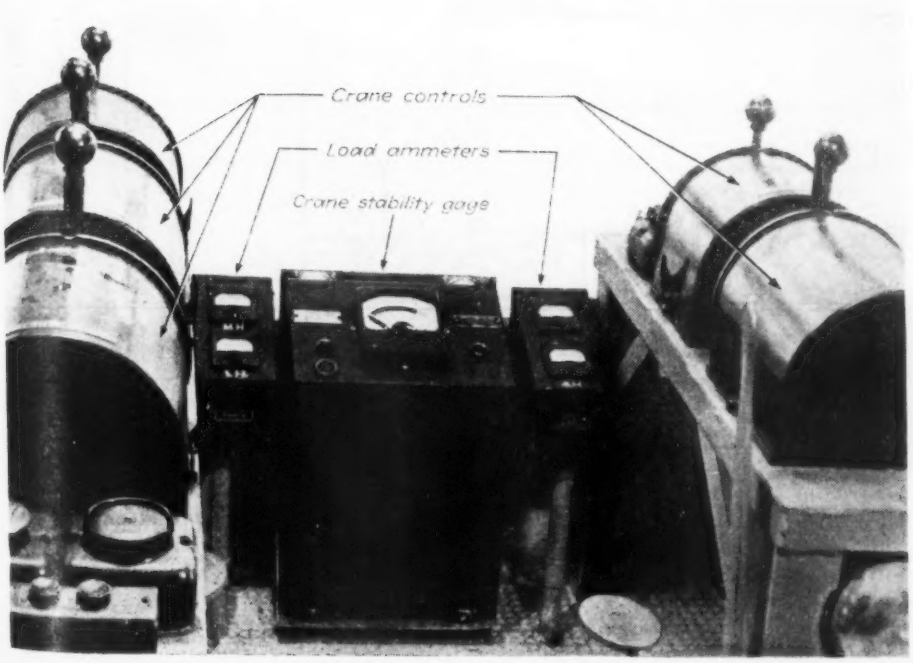
Drive Maintains Uniform Tension In Processing Movie Film

A FRICTIONAL DRIVE, developed by the Fonda Machinery Company, maintains constant tension and uniform feeding of motion picture film through a continuous developing and drying process. Rubber driving rollers, as illustrated in a partial view of the top of the machine, are above the upper film-carrying rollers and normally in contact with them. The first driving roller has the smallest diameter and each succeeding driving roller is progressively larger. The successively increasing driving speed sets up a tension in the film. It is necessary that this tension be constant throughout the developing and drying process. The design of the driving rolls is such that they cause a slow but constant increase in film tension. To maintain automatically the film tension at its predetermined figure, the upper film-carrying rollers are mounted on shafts, the bearing saddles of which are suspended on spring-mounted bolts. When the film tension exceeds the predetermined amount as established by the adjustment of the bolt springs, the upper film-carrying rollers are drawn downward and away from the driving rollers. Thus driving ceases until sufficient slack has accumulated to relieve the tension. The springs then lift the film-carrying rollers into contact with the driving rollers. This type of drive is used exclusively for motion picture film but it might be highly adaptable to handling strip metal, paper or various textile products where contraction or expansion of the material might cause difficulty in maintaining uniform tension.

Electric Strain Gage Prevents Overloading Boom-Type Crane

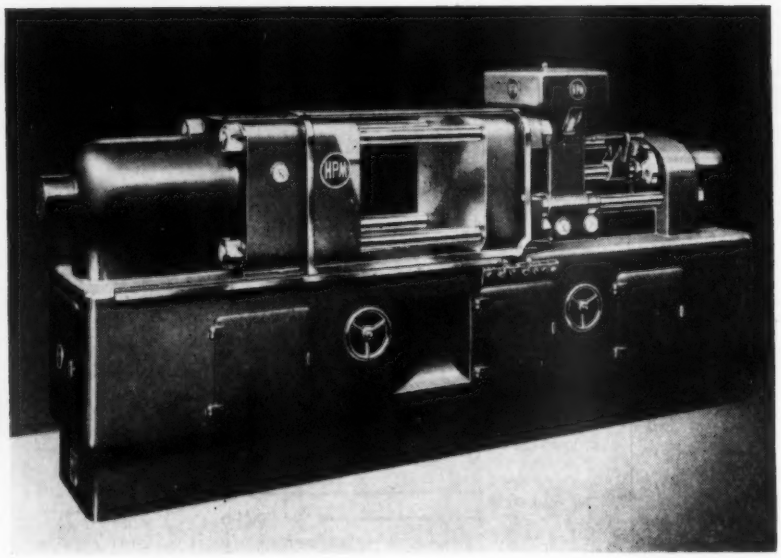
STRAIN GAGE MEASUREMENT of structural deformation determines the tipping moment or degree of crane stability in a new device designed by the Special Products Division of the General Electric Company. Used on boom-type cranes the strain gage permits maximum safe use of the crane by continuously and accurately measuring stability against handling loads in excess of rated capacity or extending the boom to an excessive radius. Any increment deformation of the structural member, upon which the strain gage is mounted, changes a small air gap in the strain gage, and since the gage and its balancing unit form two legs of an a.c. bridge, the change causes a deflection to register on an instrument on the indicating unit.



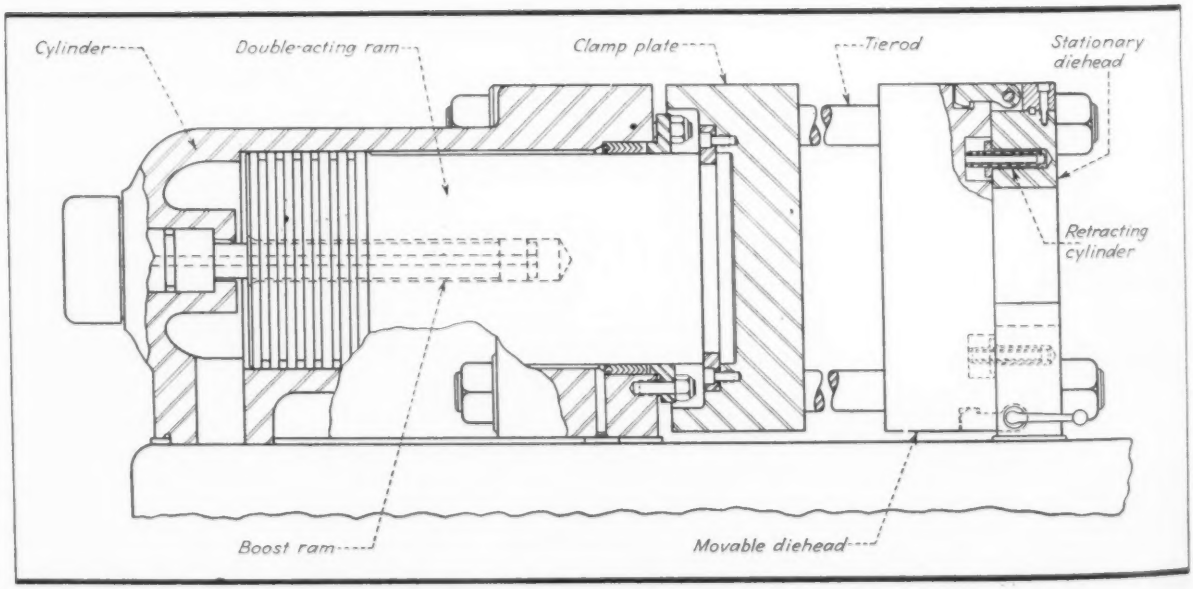


Complete stability gage consists of a strain gage and an accompanying balancing unit, an indicating unit, a constant-voltage transformer and a boom-angle compensator. The indicating unit contains a partial bridge circuit, various transformers, a sensitivity adjustment and an electronic relay for operating the alarm circuits. The constant-voltage transformer prevents interference caused by voltage variations, which would upset the gage accuracy. The boom-angle compensator is a small rotary voltage regulator compensating the gage circuit output for various boom angles.

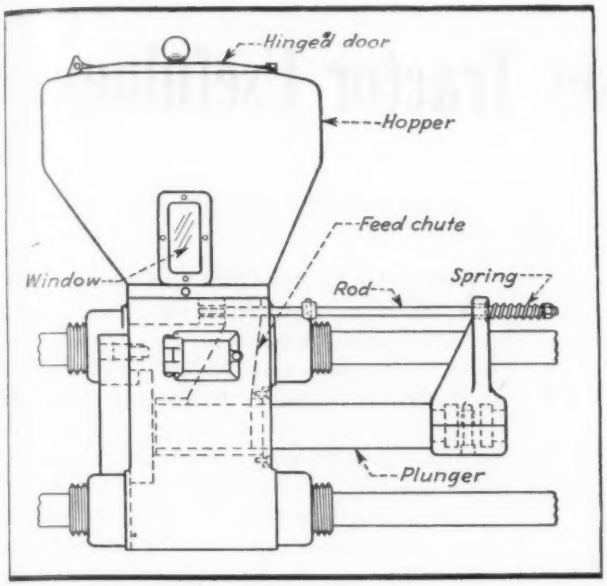
Two-Zone Heating Chamber In Injection Molding Machine



ELECTRIC BAND HEATERS with automatic temperature control provide a definite differential between zones in the new machine developed by Hydraulic Press Manufacturing Company. Material is fed by gravity from a lightweight cast aluminum hopper to a mechanism provided with automatic compensation for feeding the correct amounts of material. Base is of welded steel construction with hinged doors for servicing the hydraulic power unit and controls. A movable die-head allows access to the heating chamber.

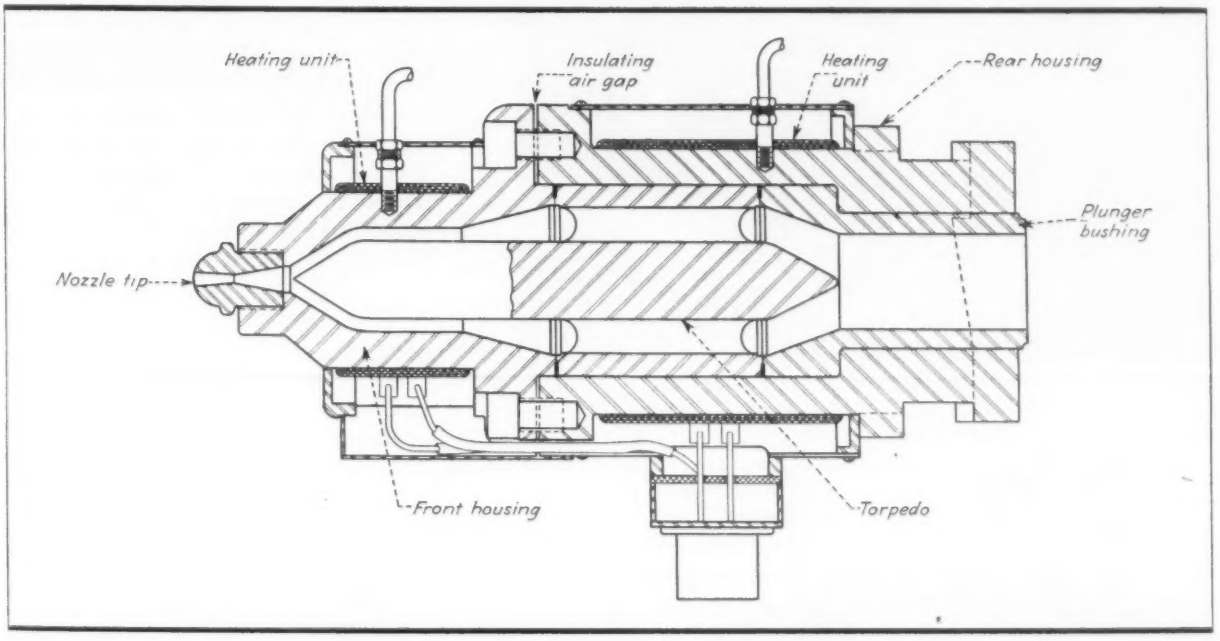


Hydraulic mold clamp consists of a double-acting ram, fitted with a small internal booster ram, which closes the clamp platen to within a fractional part of an inch of the total clamp stroke. At this predetermined position, hydraulic fluid under pressure is shifted to the large ram area. Forward mold clamp ram travel is limited by a hydraulic by-pass arrangement, eliminating stop collars on the tie rods. Ram travel is adjustable for inching. The movable die-head can be moved forward hydraulically to permit automatic retraction of the mold from the nozzle tip as well as to give easy access to the heating chamber. The stationary head has a side opening for removal of the heating chamber or nozzle for cleaning or servicing.



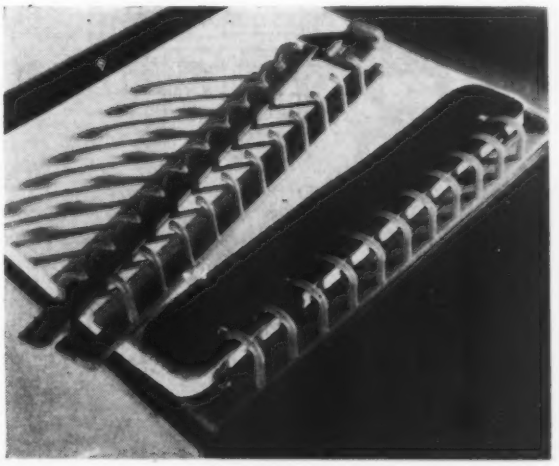
Gravity-type material feed is automatically proportioned to the output of material required. As in conventional designs, forward movement of the injector plunger measures the amount of material to be fed into the heating chamber. Return movement of the injection plunger pushes material into the feed chute by actuating a spring-loaded rod. Hinged door for filling the hopper is equipped with a window to check the quantity of molding material. The hopper is hinged at the bottom of the feed chute for easy removal when cleaning the entire feed chamber.

Material heating chamber is built with front and rear housings, the rear having a removable plunger bushing. A torpedo or spreader is clamped in position by the front housing and can be removed without removing the heating chamber from the machine. Two zones, separated by an insulating air gap, are heated by electric band heaters. It is possible to maintain a differential of 100 deg. F. between the two heating zones. Wheelco indicating temperature controls are provided for each zone. The torpedo is also heated.



Plastic Replaces Metal In Looseleaf Notebook Binder

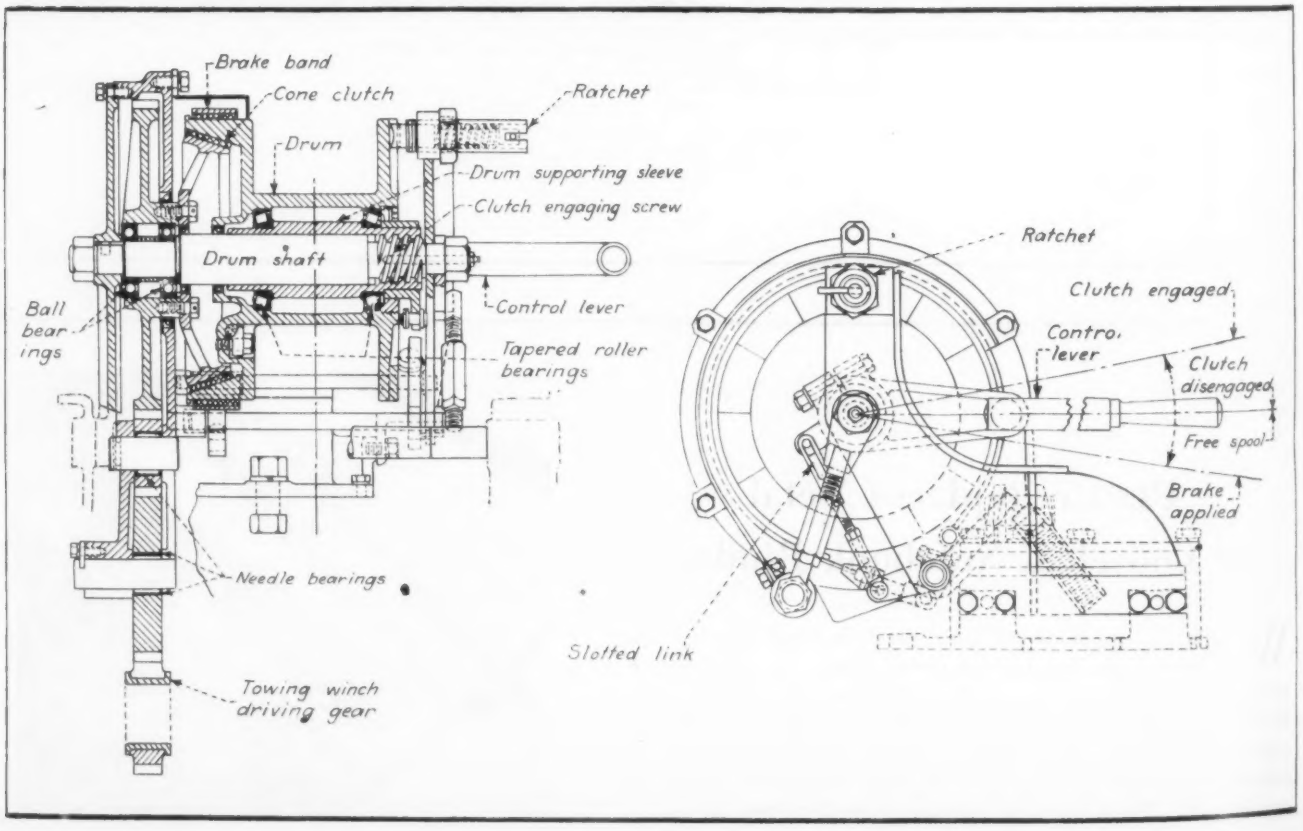
WEIGHING one-third less than metal ring and post binders, a Tenite injection molded plastic binder for notebooks is being produced by the Kampa Manufacturing Company for the Heinn Company. Paper sheets lie flat and can be added or removed by pulling out a latching flange, which swings the top end of the binder open in a scissors-like movement about the riveted end. The binder is injection-molded in two pieces.

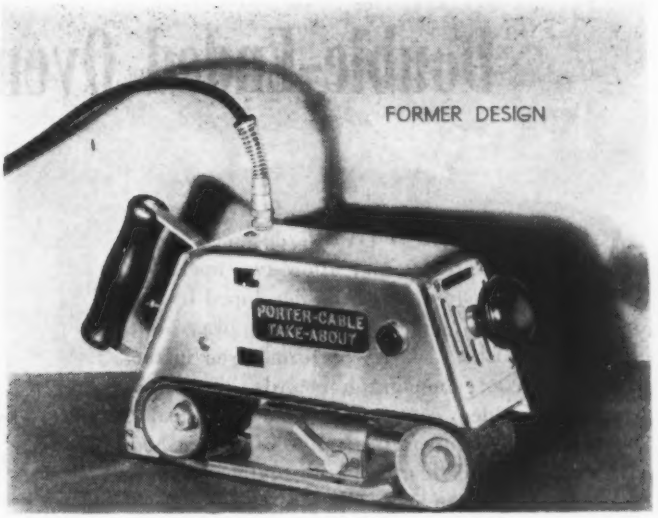


Auxiliary Drum Increases Tractor Usefulness

ADDITIONAL HOISTING and towing services can be incorporated in Caterpillar tractors by attachment of a power-driven auxiliary drum to the towing winch, as designed and produced by the Hyster Company. Driven from the towing winch by a gear, the drum is free-spooling or friction driven through a cone clutch. A single lever controls both the band brake for holding the drum, and the driving clutch engagement. A drum ratchet holds suspended loads, as in boom topping service. The unit is lubricated from the towing winch transmission.

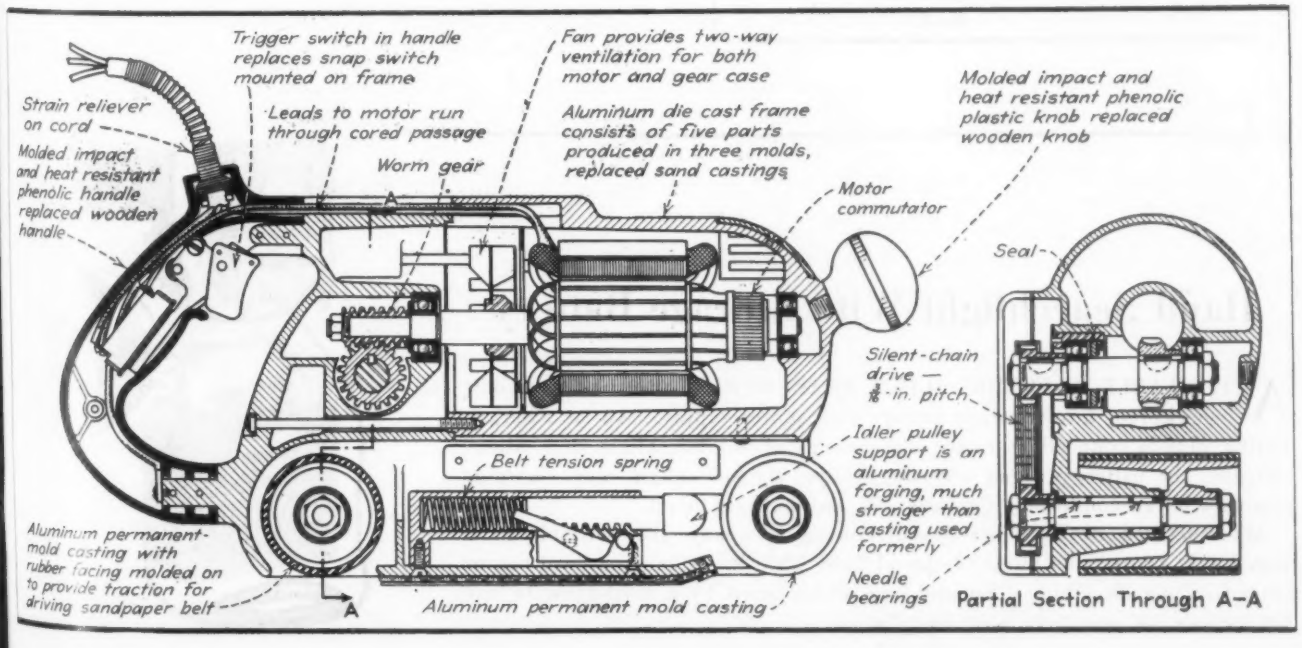
When the tractor master clutch is engaged, the cone clutch is always rotating and is fixed in its axial position. By shifting the control lever, the drum shaft with its integral clutch engaging screw is rotated so that it moves the drum axially, thereby engaging or disengaging the clutch cone. The drum is then free-spooling, but further movement of the control lever applies the band brake through the slotted link shown in the end view.





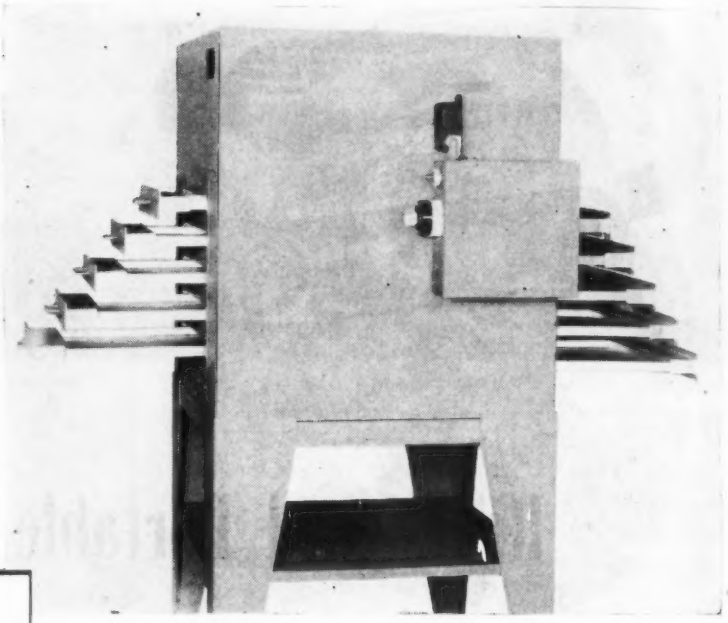
Redesigned Portable Belt Sander Is Streamlined, Operates Faster

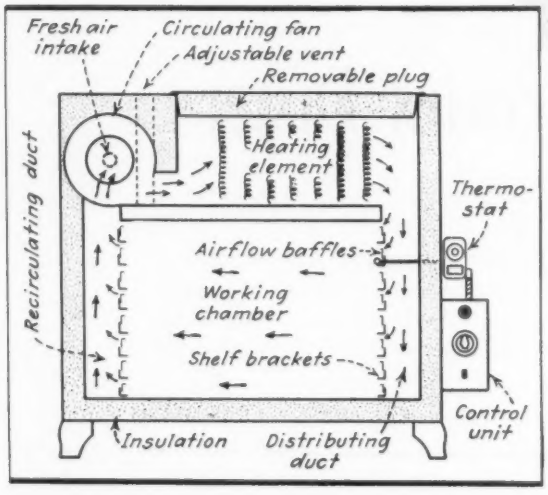
ALUMINUM die-castings are used in frame of Porter-Cable Model A-3 portable belt sander for lightness and faster assembly. Die-casting also eliminate finishing operations necessary on sand-castings used in predecessor. Sanding speed is increased with higher speed motor of same size and lower gear ratio. Ventilation also has been improved.


Trigger switch in handle replaces snap switch mounted on frame
Fan provides two-way ventilation for both motor and gear case
Molded impact and heat resistant phenolic plastic knob replaced wooden knob
Strain reliever on cord
Leads to motor run through cored passage
Aluminum die cast frame consists of five parts produced in three molds, replaced sand castings
Molded impact and heat resistant phenolic handle replaced wooden handle
Worm gear
Motor commutator
Seal
Silent-chain drive — ⅜-in. pitch
Idler pulley support is an aluminum forging, much stronger than casting used formerly
Belt tension spring
Aluminum permanent-mold casting with rubber facing molded on to provide traction for driving sandpaper belt
A
Aluminum permanent mold casting
Needle bearings
Partial Section Through A–A

Double-Ended Oven Serves Two Presses

A DOUBLE-ENDED OVEN, designed to fit between presses and allow two operators to use the same oven, has been developed by the Dispatch Oven Company. The oven was built specifically to heat plastic preforms used in the manufacture of phonograph records. The unit is of all welded construction and electrically heated with a temperature range of 150 to 500 deg. F. Ovens of this type are usually designed for each application as drawer size is determined by the size of the plastic preforms as well as the operating cycle of the press. This limitation of drawer size determines the size of the oven used.





Forced draft circulation is provided by a centrifugal fan of all-welded construction and driven by direct motor drive. The fan drives the air across heating coils into a heat duct which distributes the air horizontally by means of baffles through the working chamber and is withdrawn through a recirculating duct for reheating. This arrangement of air flow provides a uniformity of plus or minus 4 deg. F. in all portions of the working chamber. Automatic temperature control is accomplished through the use of a thermostat sensitive to within 1 deg. C. throughout the temperature range of the oven. This type of temperature control gives fast preheating of the plastic materials and the operator, working from one drawer to another, can easily coordinate the heating cycle of the oven to the time cycle of the press.

Hand Searchlight With Storage Battery

A PORTABLE ELECTRIC HAND SEARCHLIGHT uses a heavy-duty shockproof 6-volt storage battery as a power supply. An a.c. charger, having plug-in connections to the line as well as the searchlight unit, allows charging the battery without removing it from the searchlight unit. Charging can also be accomplished from any d.c. line or light plant.

Manufactured by U-C Lite Manufacturing Company, this portable hand searchlight projects an intense beam of light 2,500 ft. A snap-on head can be turned in any direction. The unit can be anchored by a hold-down to any flat surface for semi-permanent installation.

Balancing War and Peace Economies

BRITAIN is more entwined in the war effort than we are in the United States. There can be little argument with the fact that her mobilization of manpower and of all other resources for war purposes is more complete than ours.

There has been no slackening in England's improvement of war weapons and the nation has pledged itself to continue this course until the day of final victory. Her scientists and engineers are diligently developing new and better equipment with which to prosecute and win the war on land, on sea and in the air.

But this relentless and commendable pursuit of her prime objective—achieving victory—does not blind Britain to the need for making sound preparations for the days of peace that will follow this devastating war.

Britain's industries have been asked to submit blueprints of what should be done to put them in the best possible position to do the biggest possible business in the postwar period. The response has been prompt and at last reports some 200 industries had filed detailed plans with the Board of Trade in London.

More than that, the ban on the development of prototypes for postwar use has been lifted. Under certain rigid restrictions, which involve principally no greater employment of manpower than heretofore, British manufacturers can openly design postwar products. The door has not been thrown wide open because design engineers are still too few and are mostly needed on war programs. But the fact remains that British companies, since late September, can officially and legally engage in product development activities looking toward peace days ahead.

An admirable balance is being maintained between war requirements and peacetime planning. The British Government realizes that many factors make it wise not to ignore the latter—as quick reconversion as possible so as to maintain employment and absorb returning soldiers into civilian production, the necessity for replenishing the pitifully inadequate supplies in the hands of the British people, the desire to rebuild speedily Britain's place competitively in world markets.

With the war almost on her doorstep and with German V-weapons serving as a daily reminder that the enemy still is using his skill, cunning and inventive genius to devise new and more destructive and barbaric war weapons, Britain cannot forget that her engineers must devote their major attention to the No. 1 task of winning the war. The British people are realistic enough to appreciate, on the other hand, that the end of hostilities can come suddenly and unexpectedly and that it would be little short of national disaster to face the day of peace with no clear-cut and intelligent plans to solve the economic problems that will then confront them.

Though we here obviously face hard and discouraging days and new war programs are pressing upon us, we must maintain a proper balance like the British. We cannot do other than concentrate most of our designing and developing work upon the war effort. We must not, however, lose sight of the fact that peace may not be so far away as it looks at the moment, and that postwar development, within its proper sphere, is as important and essential to the national economy as winning the war itself.

G. F. Rodenhold

Design of Hydraulic Systems

I—Pumps and Their Application

HOWARD FIELD, Jr.
Consultant

Description and analysis of the characteristics, advantages, limitations, and control of the output of types of pumps suitable for use in hydraulic systems. Pumps of the following types are discussed: centrifugal, gear, vane, and piston. First in a comprehensive series of articles analyzing various types of pumps, packings, motors, cylinders, power systems, accumulators, special circuits and valves.

BEFORE a hydraulic system can be designed into a machine, the engineer must carefully study the advantages, limitations and design of system components such as pumps, packings, valves, motors and cylinders. The first of these, the pump, power or manually driven continuously or intermittently, furnishes the hydraulic energy to operate the system. Hydraulic pumps are of the following types: Centrifugal pumps; gear pumps; vane pumps; piston pumps.

Centrifugal Pumps

Multi-stage centrifugal pumps can be used in built-in hydraulic systems but are not well adapted to this service since they are inherently large-volume low-pressure units. A low-pressure system is uneconomical as it requires a large, heavy, cumbersome pump and large tubing whereas smaller, lighter, and more easily installed units operating at high pressures perform with equal reliability. Use of multi-stage centrifugal pumps for hydraulic operation is limited to plant installations where a central pumping station supplies numerous machines in the shop.

Gear Pumps

Basically the external gear pump consists of a housing which closely fits two rotating gears of the spur, herringbone or helical type. Back flow from the discharge port to the inlet port is prevented by the close fit between the gears and the housing and the meshing of the gear teeth. It is obvious that the gears must be made accurately and that the housing fit closely or the leakages through the clearances would be excessive. Another limitation in the pump is the large bearing loads created by the difference between the high pressure in the discharge port and the low pressures on the gears at the inlet port. This high thrust load has been corrected in a patented construction by the use of pressure balancing areas.

Usually the greatest source of leakage, is the clearance space between the gear sides and the housing end plates. Leakages past the teeth in mesh, past the outer diameter of the gears, and past the gear faces, are additive and together may reduce the volumetric efficiency to as little as 60 percent. For a given temperature and pressure the volume of leakage is almost uniform regardless of the pump speed. Hence at low r.p.m., the pump may maintain the pressure but have practically zero discharge, hence zero volumetric efficiency, while at high r.p.m. its volumetric efficiency may be 80 to 90 percent. It is important that the materials used in the housing and gears be carefully selected with regard to their relative coefficients of thermal expansion, if the pump is to be used at varying temperatures, as otherwise the clearances will change with temperature. At extremes of temperature the pump might either seize or the clearances become excessive.

Leakage at the gear faces can be minimized by allowing the end plates to float, the hydraulic pressure developed by the pump holding them against the gears.

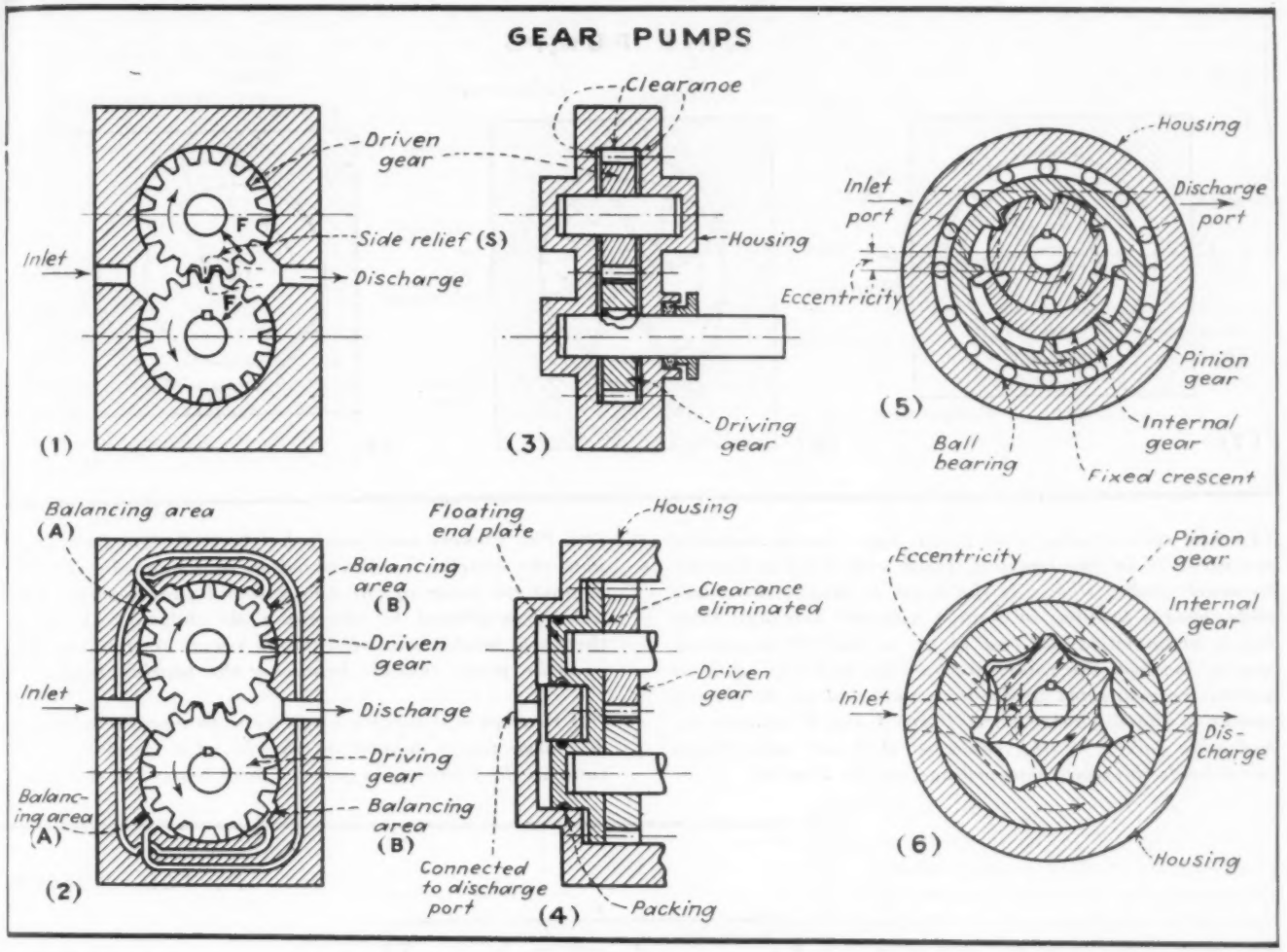
Of the internal gear-type pumps, one design, made by Sundstrand, uses a special form and spacing of gear teeth to increase the length of leakage path. Another type of internal gear pump, the Gerotor, is similar in that a pinion drives an internal gear, the tooth form of the pinion and gear being such that there is contact of each pinion tooth with some part of the internal gear at all times. Normally the pinion has one less tooth than the gear. Because these pumps have few gear teeth, the output pressure ripple is usually higher than for the external gear pumps with greater number of teeth.

All the gear-type pumps have quite similar limitations and advantages. All pumps of equal workmanship and material give quite similar volumetric efficiencies although there is an increase in efficiency favoring the floating end-plate type. The mechanical efficiencies are little different except the balanced type is somewhat better. Dirt or abrasive in the fluid is detrimental to all of them as it is to all high-pressure pumps. Gear pumps all deliver constant volume at constant speed.

It is readily appreciated that the viscosity of the fluid has a great effect on the efficiencies of the pumps. The higher the viscosity the more efficient the pump, since leakage is less, until the point is reached where the viscous drag becomes of greater significance than the reduced leakage. This does not mean that a more viscous fluid will necessarily make a hydraulic system more efficient than a less viscous fluid. The over-all efficiency is best with a fluid whose viscosity is such that the system losses plus the pump losses are a minimum for a period of operation. The best point of compromise depends upon the particular system.

Vane Pumps

Vane pumps are of several types and constitute another class of rotary pumps. In general, it might be said that they have the same advantages of size, simplicity, and low cost that are characteristic of gear pumps. However, vane pumps, when compared with gear pumps, usually maintain their efficiency for a longer time but are not as suitable to such high pressures.



(1) External gear pump. Fluid entering the inlet is trapped in the spaces between the gear teeth and carried around to the discharge port. Side relief S is provided to prevent fluid from being trapped while gears are meshed. Arrows F indicate thrust loads caused by high pressure at the discharge ports.

(2) The Vickers external gear pump balances high thrust loads by the inclusion of balancing areas, A for the pressure B for the inlet, opposite the ports.

(3) Leakage in external gear-type pumps occurs through the clearance spaces between the outer diameter of the gears and the housing and between the gear faces and the housing end plates.

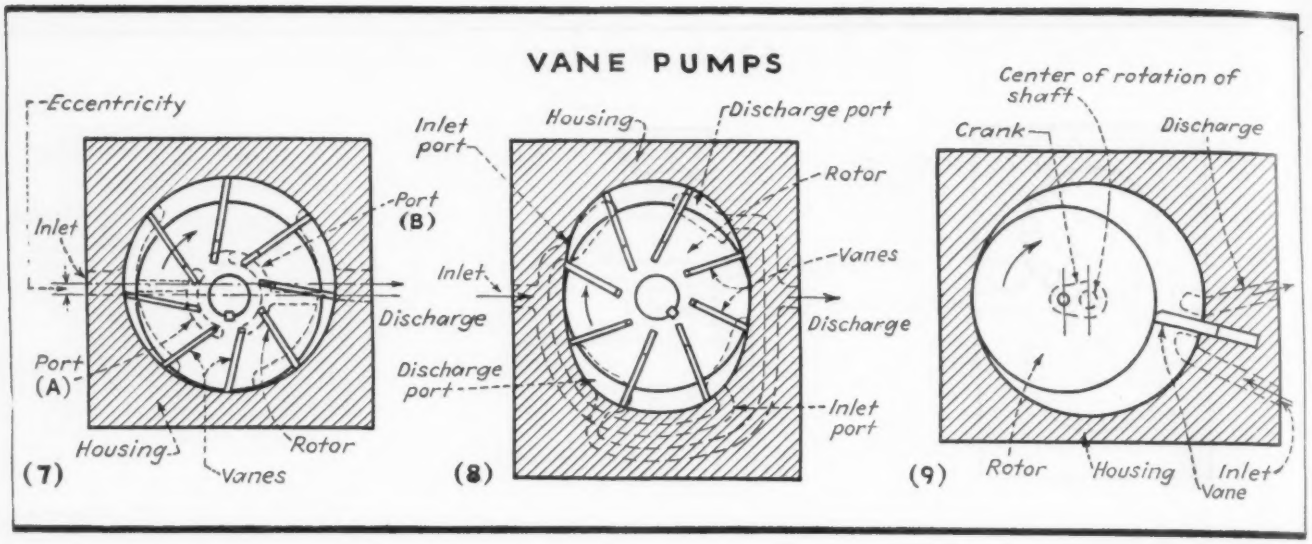
(4) Elimination of leakage past the gear faces of one gear-type pump is accomplished by allowing the end plates to float and holding them against the gear faces by the hydraulic pressure developed in the pump discharge.

(5) The Sundstrand internal gear pump has a pinion gear which drives the internal gear carried in the housing on a roller bearing, the internal gear being eccentric with respect to the pinion. Fluid enters the gear tooth spaces of both gears and is carried to the discharge port. Back flow is prevented by gear mesh and close clearance with the fixed crescent.

(6) The Gerotor gear pump consists of an internal gear mounted in a housing eccentric to the pinion which drives it. All teeth of the pinion are always in contact with some portion of the internal gear, thus fluid is drawn in as the gear spaces increase and is forced out under pressure as the gear spaces decrease.

The output of vane pumps, limited to a small number of vanes, usually has greater irregularity, or pressure ripple, than that of gear pumps with a greater number of teeth.

Basically the vane pump consists of a rotor with nearly radial slots machined in it. In these slots close-fitting hardened vanes slide outward until contact is made with the housing. As the rotor is turned the volume of any space bounded by the rotor, the housing, and two adjacent vanes is changed. Porting is located in the end plates so that fluid is drawn in from the inlet and squeezed out through the discharge. As the vanes slide in and out of the slots, the volume of the spaces at the bottoms of the slots changes. In some pump designs, these spaces are all connected to the inlet side of the pump and springs are used to hold the vanes in contact with the housing. In other designs, the spaces are connected to the discharge port so the pressure developed by the pump holds the vanes outward. Both of these methods result in friction since the vanes are held against the housing with much more force than is necessary on the inlet side. If these spaces are properly ported the hydraulic forces on any vane are always in balance and centrifugal force holds the vanes outward with sufficient but not excessive force. An additional advantage is that the



(7) The conventional vane pump has a rotor, mounted eccentrically in the housing, fitted with hardened vanes in nearly radial slots. As the rotor is turned the vanes slide, always keeping in contact with the housing. Porting is arranged in the end plates so that all increasing spaces, between the rotor, the housing and two adjacent vanes, are connected to the inlet port and all decreasing spaces to the discharge port. Ports A and B balance the hydraulic forces on the vanes so that only centrifugal force holds the vanes outward against the housing

(8) The Vickers vane pump has been designed to eliminate the bearing loads caused by unbalanced pressures against the rotor of the conventional vane pump. This was accomplished by designing the housing shape so that two intakes and discharges occur at diametrically opposite ports, thereby balancing the bearing load.

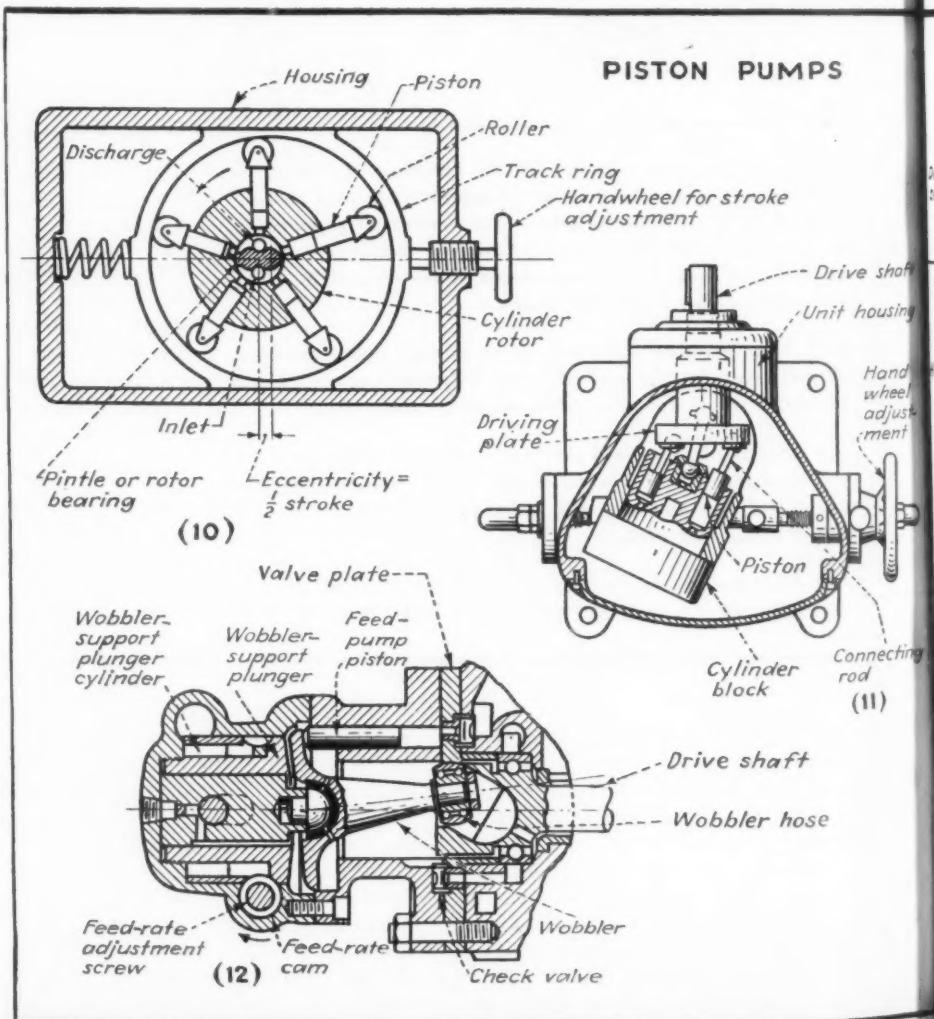
(9) Vane pumps using a single vane to separate inlet and discharge ports, depend on the fit of a crank-operated rotor in the housing, to prevent fluid bypassing the rotor.

small volume of fluid pumped by the reciprocation of the vanes is added to the regular discharge. It is evident that the eccentricity between the housing and rotor directly affects the volume of fluid discharged per revolution of the pump. If there were no eccentricity, no fluid would be pumped because the variable spaces would remain constant. Some pumps have controls for varying this eccentricity and, consequently, the discharge volume.

The bearing loads on this type of vane pump are very large because of the unbalanced pressures against the rotor and vanes. Vickers manufactures a vane pump which balances the bearing loads and at the same time gives two cycles of inlet and discharge in each rotor revolution, however, this pump does not have variable discharge.

A vane pump using a single vane to separate the inlet and discharge ports has its rotor carried on a crank which sweeps the rotor around the housing. The fit between the rotor and the housing prevents fluid bypassing the rotor. This design has the disadvantage of requiring extremely accurate workmanship and being more affected by abrasive in the fluid than other vane pumps. Mechanical efficiency is high, due to the single sliding contact of the vane on the rotor, but the pressure ripple in the output, caused by the single vane, is correspondingly great.

A characteristic of all vane pumps



is their rapid breakdown if design pressures are exceeded. This is caused by the side loads on the vanes and the relatively weak section of the rotor at the root of the vane slots. If correct pressures are not exceeded, however, vane pumps generally outwear gear pumps, particularly if dirt is present in the fluid.

Piston Pumps

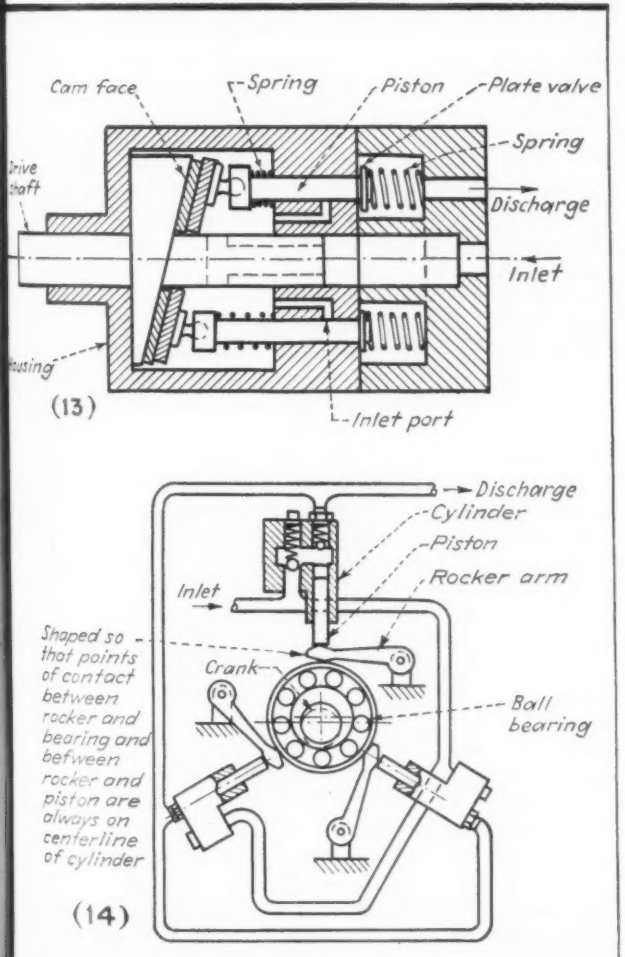
Piston pumps are used wherever high pressures and accurate control of discharge volume are required, and are adaptable to higher pressures, in a single stage, than other pump types. It is possible to arrange any type of pump in a double-stage unit thus doubling the output pressure, but pump efficiency usually suffers unless the first stage is arranged to supply exactly the amount of fluid used by the second stage. Another way of being sure that the second stage is adequately supplied is to make the first stage of slightly larger capacity and then bypass the excess fluid through a relief valve with consequent loss of efficiency.

The simplest form of piston pump is the well known master cylinder used in automobile brake systems, and also in some remote control systems, where manual effort is sufficient to perform the service. Some elements are usually added because the basic unit can operate only in one direction and hence some means must be provided to return the plunger. In remote control systems there is the added requirement of providing compensation for thermal expansion and leakage.

The old multiple-cylinder vertical pump, now obsolete, has been replaced by more compact designs. Modern piston pumps frequently have a radial arrangement which allows adjustable volume discharge but may have fixed eccentricity when lower cost and fixed volume discharge is desirable. The pressure ripple in the discharge of piston pumps may be quite large, depending upon the number of cylinders. The smallest number of cylinders ordinarily used is five, but most pumps have more.

Many piston pumps, particularly the smaller sizes, are arranged with their cylinders parallel to the axis of rotation, thus making a more compact and less expensive unit. Piston stroke depends upon the angle between the axis of rotation of the drive shaft and the axis of the cylinder block, and when this angle is zero the pistons have no stroke. A handwheel adjusts this angle and, consequently, the discharge of the pump.

In all pumps discussed thus far, the variable-volume fluid chambers have moved in respect to the housing. This has made possible the provision of simple inlet and discharge ports with which the chambers registered. Simple porting is not possible in a type of piston pump, made by Sundstrand, in which the chambers are fixed and pistons move. The pistons are moved into the fixed cylinders by the motion of the wobbler, which does not rotate but is forced to gyrate about its spherical bearing. The return of the pistons is accomplished by hydraulic pressure in the inlet manifold maintained by a gear pump. Each cylinder has two check valves, an inlet valve and a discharge valve. The cavity in the end of the drive shaft, in which the nose of the wobbler is carried, is not parallel to the axis of the drive shaft, but rather intersects it. As the wobbler is moved



(10) A radial piston pump consisting of a fixed pintle about which turns a rotor, containing the cylinders and pistons. The pistons are positioned by a track ring which can be adjusted to vary the eccentricity between rotor and track ring, thereby adjusting the length of the piston strokes. Inlet and discharge ports are machined in the pintle.

(11) The Vickers piston pump consists of a driving plate and cylinder block assembly. Pistons are driven through connecting rods attached to the driving plate. Stroke of the pistons depends upon angle between the driving shaft and cylinder block. The handwheel adjusts this angle and controls the pump discharge.

(12) The Sundstrand piston pump has fixed chambers. Pistons move in and out by the motion of a wobbler, which does not rotate but is forced to gyrate about its spherical bearing. Each cylinder has two check valves, one allowing inlet to the cylinder, the other allowing discharge to the proper manifold. Return of the pistons is accomplished by having the inlet manifold under pressure. Pump discharge is controlled by the location of the wobbler nose in the shaft.

(13) The Hycon pump drives the pistons from a cam face on the drive shaft, and pistons are returned by springs. Discharge is through spring-loaded plate valves. No inlet valves are required as the piston return creates a suction until inlet port is uncovered.

(14) The Barnes feed pump has a crank carrying a ball bearing which actuates rocker arms to reciprocate the pistons in the cylinders. Return of the pistons and rocker arms is accomplished by hydraulic pressure supplied to the inlet manifold by a gear pump.

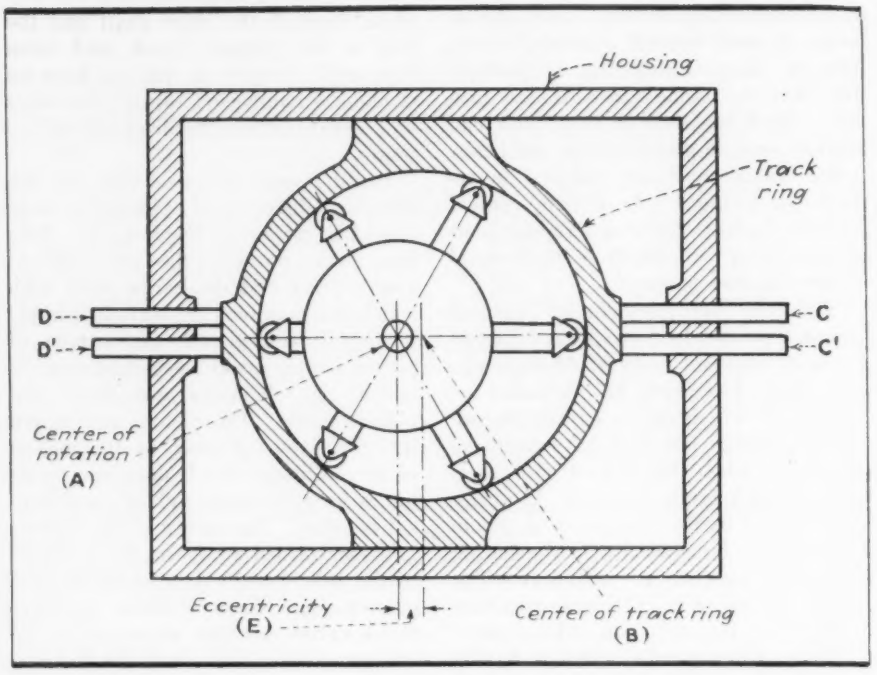


Fig. 1—Diagrammatic sketch of a radial piston pump illustrates how different methods can be used to control the discharge volume of a hydraulic system

into the drive shaft, its nose is brought closer to the axis of the drive shaft and hence constrained to move in smaller circles, thus reducing the amount of wobble and the amount of fluid pumped.

Another design of wobbler pump is the Hycon, made by the New York Air Brake Company. In this pump, the pistons are driven into the cylinders by the cam face on the drive shaft and are returned by springs. The discharge valves are of the plate type and are actually lifted slightly by contact with the ends of the pistons. There is no inlet valve as such, a suction being created in the cylinder as the piston returns until an inlet port is uncovered. The pump has zero clearance, hence no space in the cylinder is unswept by the piston, and the inlet scheme works well. This pump has the characteristics of a constant-displacement pump, but a scheme of throttling the inlet so that all cylinders are partially starved is used to give variable-volume discharge. This means of flow control would be difficult to apply to pumps of other construction, and would appear to give considerable shock even in this case. Parenthetically, it might be said that one of the surest ways to destroy a pump is to starve it, particularly when the discharge is at high pressure.

There is one other general type of fixed cylinder piston pump, of which the Barnes feed pump is an example. This pump has crank-operated rocker arms, which in turn operate the pistons. Return of the pistons and rocker arms is accomplished by hydraulic pressure from the inlet manifold, which is maintained at pressure by a gear pump. The stroke of the pistons may be varied by changing the throw of the crank or by limiting the return of the rocker arms. The latter method causes considerable shock.

Pump Control

It will be seen that most of the pumps, except those of the gear type, are capable of giving any delivery from maximum to zero, and some may even be reversed. This variable-delivery feature is of great importance for such things as roll drives in a strip mill, holding with a press and starting of heavy machinery. Design requirements have led to the development of many attachments to control the pump discharge. Some of these may be illustrated by considering Fig. 1, which is a simplification of a radial cylinder pump. Here, *A* is the center of rotation of the cylinder rotor, *B* is the center of the track ring, *E* the eccentricity, *C* and *C'* a means urging the track ring to the left, and *D* and *D'* a means urging the track ring to the right.

The simplest control is a manual adjustment of the eccentricity. For this, *D* could be a spring and *C* a screw and handwheel. As *C* is screwed in, the eccentricity gets less and the volume of discharge decreases. When the eccentricity is zero, the discharge is zero, and further motion of the handwheel reverses the flow. This control is used where the speed of an operation must be adjusted as, for example, the rate of feed for a machine tool.

The next most common control is a maximum pressure control. For this purpose, a hydraulic cylinder is connected to the discharge of the pump at *C* and an adjustment for maximum eccentricity at *C'*. At *D*, a spring is used with a screw adjustment to vary the spring load. The relation between the spring *D* and cylinder *C* is such that the cylinder shifts the track ring to zero eccentricity, overcoming the spring load at the desired pressure. This sort of control is used on presses which may be required to dwell under pressure. It may also be used in the first stage of a two-stage pump.

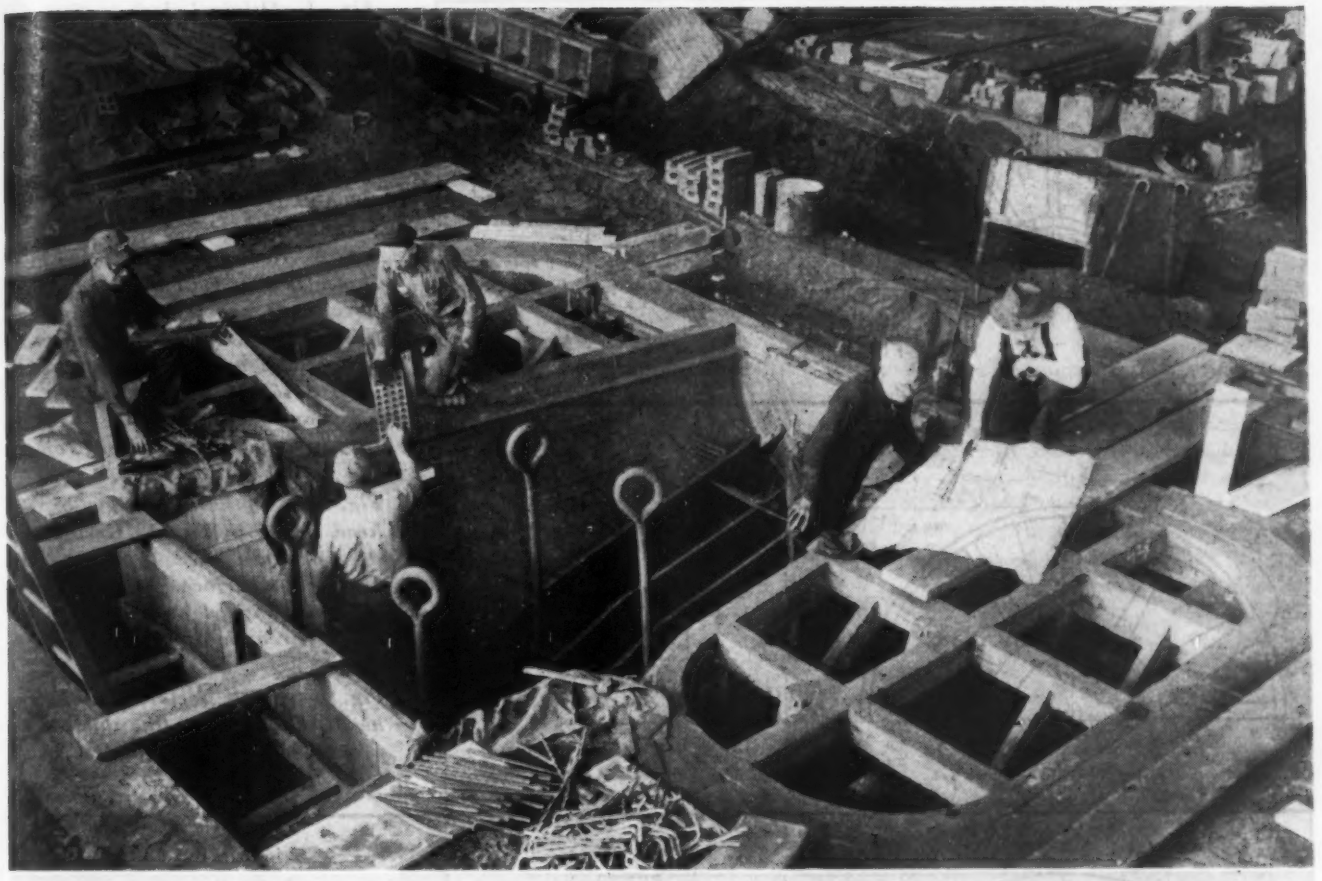
A variant of this consists of using two springs at *D* and *D'*. Spring *D'* is housed so that it can act only for, say, eccentricities from zero to one-third maximum. The two springs together act against the cylinder *C* to determine the maximum pressure. This control gives full volume until some pressure is reached at which the volume reduces to some predetermined amount at which it remains until maximum pressure is approached. This is used for such purposes as the rapid closing of a press, followed by a slow work stroke, and permits the use of a driving motor much smaller than the sizes which would have been required had the simpler pressure control been used.

There is also the possibility of using hydraulic cylinders at both *C* and *D* which are supplied with fluid from an auxiliary system and controlled by suitable valves. By this means, it is possible to obtain almost any conceivable control of both pressure and discharge. For example, in a press, we could obtain an automatic cycle of rapid close, slow work stroke, dwell, slow relief, rapid opening, and at the same time stop instantly whenever a safety stop solenoid valve was energized.

A pump is one of the most important units in a hydraulic system, and, unfortunately, one of the most critical. There are so many types, all of which have slightly different characteristics, that the choice of the proper one for any particular application is not a task for the blind or willful, but rather one for careful study and facts.

The second of the series of articles on the design of hydraulic systems will appear in the February issue. This article will discuss the characteristics and use of packing.

The author gives many suggestions, based on his wide experience in the design of hydraulic systems, which will assist the designer in the selection of the proper type of packing.



Preparing a mold in a pit. Pattern is in place and ready to have the sand rammed around it. Detailed consideration of the design by engineers and foundrymen has preceded the construction of the mold.

Design Proportions Affecting Qualities of Castings

J. A. WETTERGREEN, *Superintendent,*
Schenectady Foundries and Pattern Shop, General Electric Company

Design rules that help in the production of satisfactory castings and in the reduction of foundry costs. Original designs and redesigns are described to show that many production difficulties can be avoided both in making and in finishing the casting by understanding the variables in foundry technique and operations.

DESIGNERS do not always appreciate their opportunities to control the quality and cost of castings. Many basic considerations are involved in foundry practice and the inherent behavior of molten metals, which when disregarded result in castings that satisfy neither the foundryman nor the designer.

The casting process is subject to a number of variables. The success of the foundryman in producing a satisfactory casting, is a measure of his skill in controlling these variables. Engineers often can simplify the work in the foundry by discussing a few of these variables with the foundryman when designing castings and writing essential specifications.

HAND WORK PREDOMINATES. To a greater degree than in almost any other basic manufacturing process, the quality and cost of the cast product is the result of the skill of individuals.

CONTROL OF MOLTEN METALS. Temperatures, analyses, fluidities, and inclusions possible with regard to molten metals cover wide ranges.

EQUIPMENT AVAILABLE. Few foundries are called upon to make all types of castings, that is, thin or heavy sections,

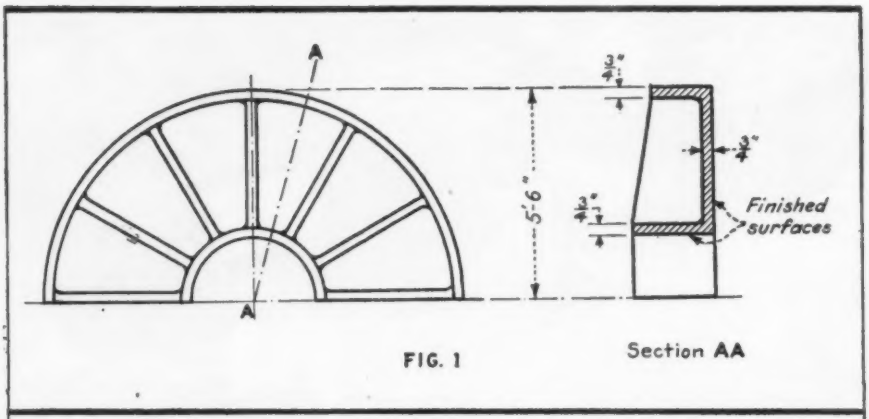


FIG. 1

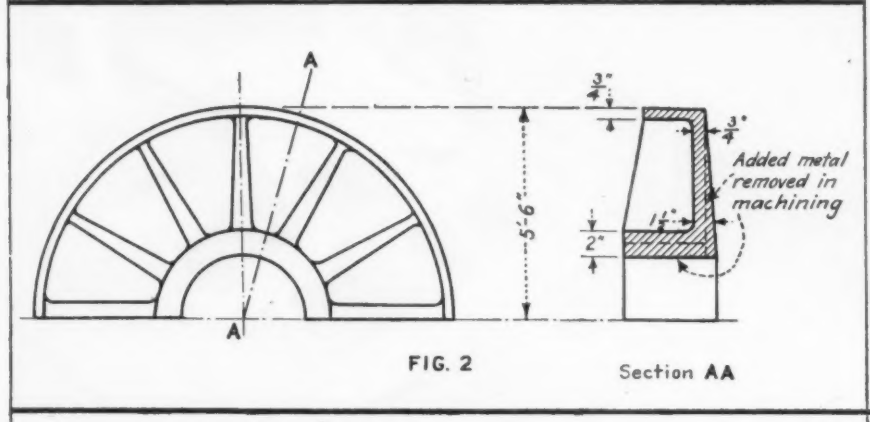


FIG. 2

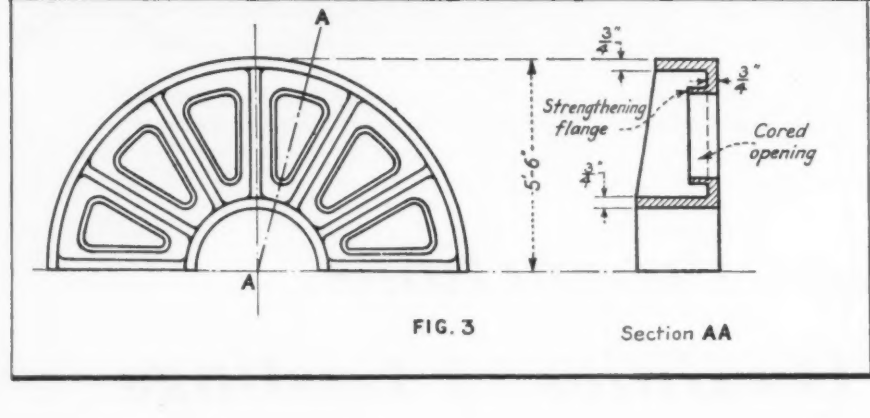


FIG. 3

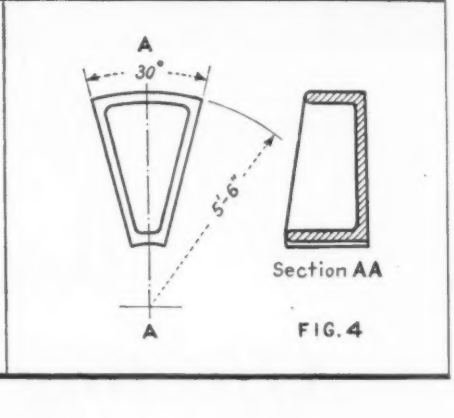


FIG. 4

Fig. 1—Original design of a cast steel head for high pressure service. With this design it would have been difficult to avoid inclusions on the surface to be finished, cracks along radial ribs, distortion, cold-shuts in web, and shrink at junctions of ribs and web.

Fig. 2—Redesign of cast steel head shown in Fig. 1. The ribs and web have been tapered, and the hub thickened. Extra metal must be removed in machining, but the redesign favors sound castings at lower overall cost because of reduction in repair expense and rejects.

Fig. 3—Another redesign of the head shown in Fig. 1. Here cored openings are used to reduce the area of flat surface. Edges of openings are flanged or beaded to increase strength of casting.

Fig. 4—Small sector of pressure head. Twelve parts like this can be assembled to form complete head.

pressure or structural castings, cored or plain designs. Therefore, most foundries are equipped to make only a few definite types of castings. When conditions force the foundryman to enter a field that is not well known to him, quality or cost often suffers. For example, shrinkage characteristics, temperatures, fluidity, physical properties, and inclusions are often influenced by the type of furnace in which a metal is melted.

KINDS AND QUANTITIES OF MATERIALS. Several times the weight of a casting is consumed in materials other than metals during the making of a casting. The list includes fuels of several kinds, sand, various binders for the sand, mold washes, fluxes, and refractories.

Each material is subject to its own variations. When combinations of materials are used the difficulty of controlling the result is increased. If molding sands and mold washes are not correctly porportioned, the wash will tend to "peel" under the action of molten metal. This effect is most apparent on large inverted surfaces which are subjected to radiant heat for an extended period of time. The size and shape of castings influence the degree of hazard involved in this type of foundry problem. Observance of the following design rules will simplify the foundry problem and result in better castings.

1. Taper the sections so that they approach the simplest shape to cast, that is, an inverted cone. This will make it possible to tilt the mold or even "up-end" it during the pouring operation, so that pouring can be done rapidly, thus minimizing the tendency to "peel" or "burn in."

An original design and an improved design of a high-pressure steel head casting are shown in Figs. 1 and 2; the ultimate in soundness was required. Through redesign, chronic defects were eliminated and sound castings produced. The principle illustrated is termed by foundrymen "directional solidification." In practice, the casting is poured "uphill" with the hub elevated at an angle of 15 or 20 deg. from the horizontal. Using this method, metal can be poured into the mold quickly so that the large flat surfaces of the web are not subjected to the radiant heat of the molten metal for an extended period of time.

2. Use cored openings to minimize the area of flat surfaces. Openings can be closed when necessary by welding in or bolting on covers. Required strength of the casting can usually be obtained by providing flanges around such openings. Fig. 3 shows a redesign of the casting shown in Fig. 1. In this redesign, cored openings reduce the area of large flat surfaces. This treatment is

not as desirable as the redesign shown in Fig. 2, but is often the correct solution when weight limitation is a factor. The ultimate soundness of the casting is often worth the increased cost.

3. Design the casting in small pieces which can be assembled to form complete unit.

In the redesign of casting shown in Fig. 4 the original design, Fig. 1, was simplified by casting small pieces which could be assembled to form a complete head. The casting hazards were greatly reduced, but the over-all cost was increased.

The examples given here were chosen for simplicity in illustrating the principles involved in solving one specific type of problem. They are good illustrations of the benefits that can be expected from full cooperation of foundrymen and designers. There are many other factors, not revealed in this discussion, that would also influence the final decisions in redesigning specific cases which involve the principles illustrated.

Foundry operations can be classified generally into two groups: Making the casting, and finishing the casting. Costs for finishing, sometimes called cleaning, range between 25 and 75 percent of the total depending upon the type of metal, use of the casting and its design. Type of metal and use of the casting are usually determined by the requirements of the service for which the part is intended. But design can be controlled by cooperative action of the engineer and foundryman.

Design and foundry factors which effect the cost of finishing are choice of parting lines, risers or feeding heads, and the requirements for good appearance.

CHOICE OF PARTING LINES. Parting lines must occur at the junction of parts of a mold and at the junction of cores. Each parting line may be a source for fins which must be chipped or ground off the casting when finishing. Also the foundryman desires to minimize and simplify parting lines because they are usually associated with irregularities in the casting contour, dimensional variations, poor appearance, and increased risk of defective castings. Certain designs leave the foundryman almost no latitude in locating parting lines.

A cast box and cover as originally designed and as improved by consultation between the designer and the foundryman are shown in Figs. 5 and 6. Assume that the foundryman, for valid reasons, has decided to make this casting in a two-piece flask, and that the casting is to be made in large quantities in undried molds rammed on molding machines by unskilled labor.

Because of the heavy sections in the bottom of the box, the foundryman would prefer to make this casting "upside down," that is with the joint of the box in the bottom of the mold. This procedure enables him to feed the heavy sections adequately by the use of risers, thus insuring sound sections, without resorting to the use of troublesome chills.

The intricacy of detail in the interior of the casting plus the consideration of pattern rigidity will, no doubt, bring about the decision to make the interior of the casting with cores, particularly since there are a number of castings to be made.

Having decided the position in which he will mold the casting and the type of pattern equipment, the foundryman proceeds to consider the location of parting lines. If he chooses to make the parting at *A*, he is confronted with the problem of the bolting flange all around the casting. He must decide whether or not to make this flange as a loose piece on the pattern which can be drawn back into the mold after the pattern is drawn. This is a potential source of trouble because of misalignment on the final casting. If the flange is not loose on the pattern, cores must be used all around the casting as *B*. This also leads to trouble because at the junction of core *B* and the mold there will, in all probability, be a fin at *C* all around the circumference of the corner radius of the casting. This fin will require removal and the grinding operation must be done very carefully to maintain the desired contour of the casting.

The next decision for the foundryman pertains to the parting lines for the cores which form the lugs on the bottom of the box. He must choose between the three methods shown at *D*, *E*, and *F*. *D* results in a thin edge of sand on the core which may be washed away and trapped in the castings. *E* is a costly core to make, and requires extra core joints or loose pieces, both are troublesome. *F* means extra cleaning cost to grind the fin on the radius of the lugs.

In the redesigned box, shown in Fig. 6, the foundryman's problems have been simplified and the cost of the casting reduced. The bolting flange has been incorporated into the contour of the interior of the box without affecting the cost of the interior cores. This change eliminates any necessity for exterior cores and simplifies the choice of a parting line which would, of course, be located at the joint of the box *K*. Any fin at this point will be removed in machining the joint, so that expensive grinding of the fin is unnecessary.

The shape of the lugs has been changed so that the cores are simplified as shown by *G* in Fig. 6. The parting between cores *G* and the mold is at the face of the lugs. Any fin which occurs at this point can be removed in machin-

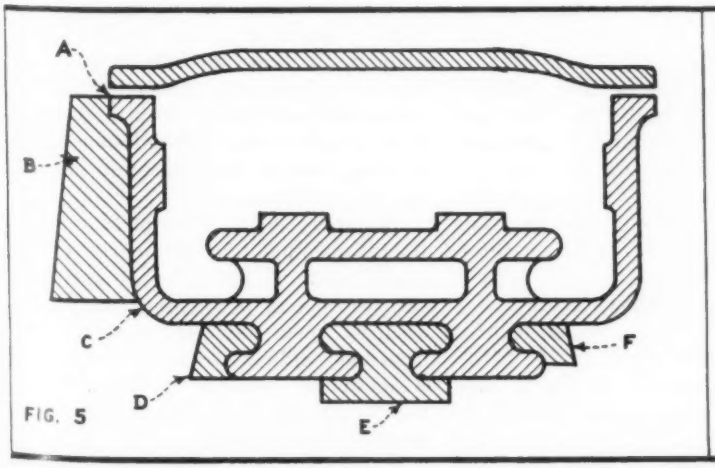


FIG. 5

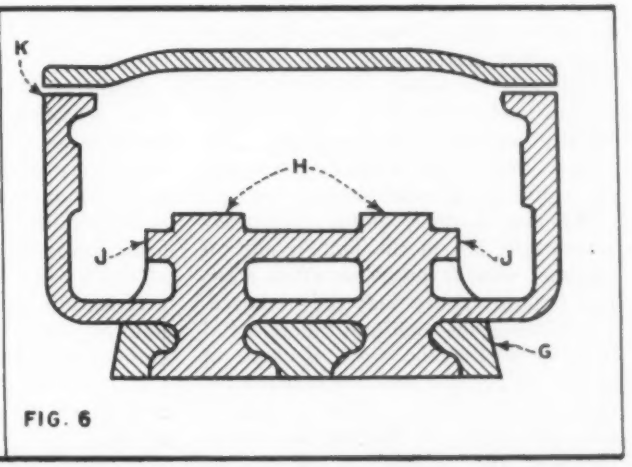


FIG. 6

Fig. 5—Section of cast box and cover in which the design features complicate parting lines and increase casting costs. Lugs at exterior of bottom of box are to be drilled for pressure connections and must be sound. Fig. 6—Redesign of cast box and cover that incorporate improvements to facilitate foundry production and decrease cost of casting.

ing, and will require little or no grinding.

The "neck" which connects the exterior lugs with the interior bosses *H* has been thickened to provide for the feeding of these bosses from risers which are to be located on the exterior lugs, assuring soundness in these sections.

The shape of the contour on the plate inside the casting has been changed from a radius to a square as at *J* in Fig. 6. This makes it possible to make the parting of the cores at a corner rather than on a radius, thus simplifying the work of grinding off fins at this point.

With these improvements in design, the foundryman has a good opportunity to produce a sound casting with considerably less cost and hazard.

A word of caution regarding the danger of generalizing from the foregoing discussion of design improvements. The design changes incorporated into the cast box used in this case certainly would not always apply under different circumstances. The redesigns described merely serve to illustrate the benefits which result from consideration of design features with the foundryman in the early stages of detailing a particular casting.

RISERS OR FEEDING HEADS. All castings must be fed during the solidifying and cooling period. This is accomplished by the use of molten metal reservoirs called "risers" or "heads." The removal of risers is a large part of the cost of finishing or cleaning. The location of the risers is influenced by the variations in thickness of metal sections, the need to minimize distortion during cooling, and accessibility for removal. Consideration of these factors in the design of a casting results in a better casting at a lower cost.

In general, the foundryman desires to mold the casting in such a position that he will be able to place the risers in the upper part of the mold. This enables him to take the fullest advantage of ferrostatic and atmospheric pressures and usually simplifies the molding procedure. Also, risers so placed frequently favor directional solidification.

When a design requires that heavy sections be fed in the bottom part of castings, serious problems often arise. Extra large risers may be required, necessitating the melting of more metal thus increasing the cost. Because of inaccessibility, the junction between the riser and the heavy section is often of irregular shape, so that the removal of the riser and finishing of the casting at that point is slow, costly, and not likely to result in a good appearance. In extreme cases, foundrymen resort to internal or external chills, pads or swells, and other "tricks of the trade", always with a realization that they are adding cost and increasing hazards which design consultation might have avoided.

In the past few years, a patented method (Williams) of facilitating the use of risers in inaccessible parts of molds for steel castings has improved the chances of success in casting many difficult designs. This method is not a "cure-all" by any means, and the basic difficulties remain, subject to a cooperative effort on the part of designers and foundrymen.

COST OF GOOD APPEARANCE. To the uninitiated, the appearance of a casting reflects the money spent for that type of finish. This is not always so. The bottom side of a casting usually has a better appearance than the top. Also, the location of the in-gate through which the metal enters the mold cavity, the choice of mold materials, and position of risers all affect appearance. Consultation on these subjects will enable the engineer to design with a better appreciation of the relation of these elements of cost to the over-all cost of the casting.

There are numerous other opportunities for the engineer to help in the production of satisfactory castings and in the reduction of foundry costs. Shape, size, thickness of section, junctions, bosses, ribs, and fillets are largely in the control of the designer.

If the designer knows from experience, or by consultation, the position in which the foundryman desires to mold a casting, he has a valuable starting point for his design. He can proceed to design sections and junctions of sections which, when possible, tend to increase in volume toward the top of the casting. A realistic approach along these lines will result in a design requiring a minimum of extra metal to be added by the foundryman to produce a sound casting.

Probably the most valuable publication on casting design is the American Foundrymen's Association pamphlet "Steel Casting Design for the Engineer and Foundryman" by Briggs, Gezelius and Donaldson. These authors have formulated several rules of design, three of which are:

1. An attempt should be made to design all sections in a casting with a uniform thickness.

2. It is not desirable to design cast steel structures with abrupt changes in section.

3. Sharp corners at adjoining sections are sources of trouble and, if possible, should be eliminated.

These rules have been formulated chiefly for steel castings because they present the most serious problems, but the principles involved are applicable to other metals.

CASTING TO BE USED IN ASSEMBLIES. The over-all cost of assemblies, or weldments, embodying castings is often strongly influenced by consultation with the foundryman on the best location for the necessary junction points. Briggs, Gezelius and Donaldson have indicated the desirability of this procedure in their "rule"—"When the design of a cast steel structure becomes very complicated or intricate, it is suggested that it be broken up into parts so that they may be cast separately and then assembled by welding or bolting."

If such details as pipe flanges or brackets, which require feeding or chilling, occur on the bottom side of castings, it is often desirable to eliminate them.

The junction points for weldments are likely to be freer of inclusions, such as dirt and gas, if they are on the bottom of castings. Clean metal facilitates welding.

If the designer desires to incorporate an irregular junction (not in one plane) into his design, consultation with the foundryman will enable him to minimize the amount of trouble this will cause the foundryman in determining partings and core shapes.

Chaplets and chills are sources of potential trouble to the foundryman. Their necessity results from certain design features. If the design does not permit the use of adequate core-prints, chaplets are often required to locate and hold the cores in place. A much better method is to modify the design to permit the use of core-prints at strategic places. In general, difficult castings in this respect are those having few or small openings into the interior of the casting.

A pipe, ten to fifteen times its diameter in length, would no doubt require chaplets to locate the core and hold it central in the mold, unless other special measures were taken at extra cost. A box-shaped casting with only one small opening through the wall would present similar problems.

Designers should attempt to provide liberal openings into the interior of inclosed types of castings. Such openings can be used in positioning cores, thus assuring metal sections specified on drawings without resort to chaplets. Also, liberal openings facilitate cleaning the casting by permitting easy removal of core sand.

It is desirable to avoid the necessity to use chills for establishing proper thermal gradients during the cooling of castings having abrupt changes in sec-

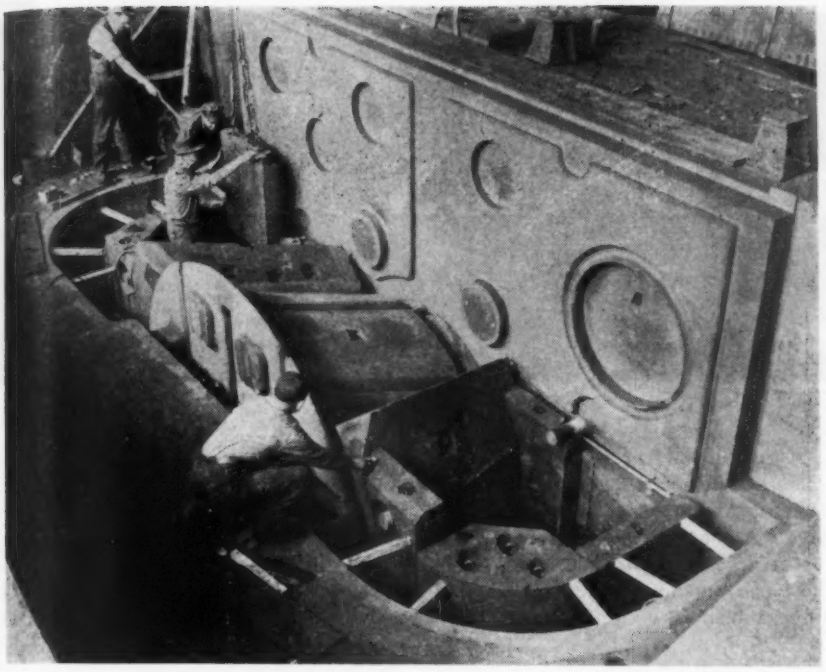


Fig. 7—Core setting in a mold for a large and complicated iron casting. Close cooperation between the designer and foundryman, when laying out the preliminary design, assured castings of high quality at reasonable cost.

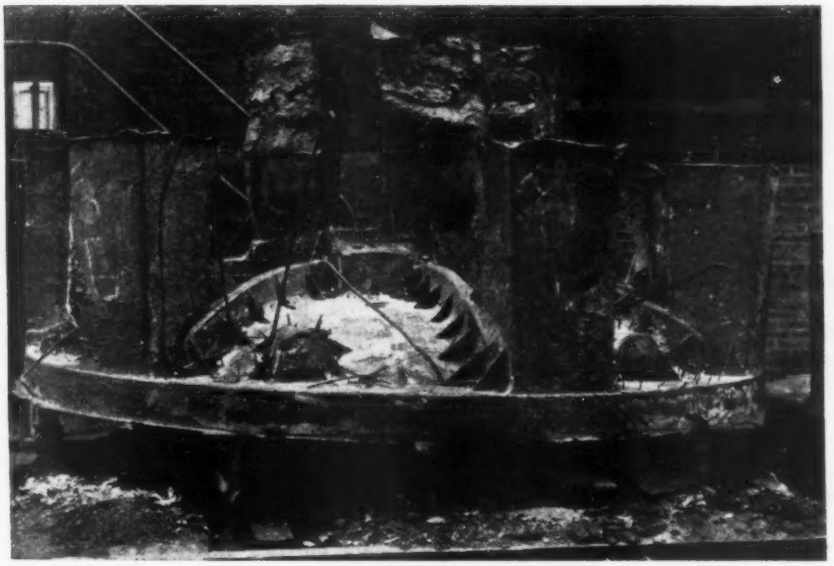


Fig. 8—Steel casting with risers before cleaning. The numerous large risers provide adequate assurance of sound metal throughout the casting. Cooperation between design engineers and foundry simplified the removal of risers which is a large part of the cost of finishing or cleaning.

tion. This can be done by minimizing the differences and tapering from one section into the next. Sometimes the foundryman can suggest other means of accomplishing the same objective without resort to these troublesome devices.

All castings are subject to imperfections of one kind or another and the foundryman is in the best position to anticipate the location and nature of possible flaws. If he knows the use of the casting, its critical sections, vital dimensions and important surfaces, he is better able to proceed with the construction of a pattern and the making of a casting which will be low in cost and have optimum quality.

Repetitive castings demand engineer-foundryman consultation to the greatest possible extent. Pattern equipment is often complicated and expensive. Original errors are multiplied in importance because of quantity production. Corrections of faults which arise from lack of cooperative effort may affect numerous other parts and operations.

The patternmaker, who is a member of the foundry organization, also needs cooperative effort. Sometimes he can suggest ways to avoid the necessity for patterns "to the other hand," that is, right and left hand patterns. Also, because wood has certain directional properties, he often can influence the dimensional accuracy of the final casting if he understands the importance of the casting in the service intended. Patterns are made of hard or soft wood or metals. The material chosen by the patternmaker affects the life of the pattern and thereby the quality of the castings. Occasionally, by suggesting slight relocations of ribs or bosses, he can eliminate core boxes. Incorporating necessary pattern draft into the design accomplishes similar economies.

Sometimes in desperation, or perhaps pride of workmanship, the foundryman takes the attitude that he can make anything. Everyone loses if this attitude prevails because the benefits of cooperative effort is lost. A clever foundryman can, and often does, produce some amazing results when working with combinations of tricky alloys, improper equipment, untrained help, sub-standard materials, and imperfect designs. But his chances of duplicating these results would be increased by a cooperative consideration leading toward simplification of the problems involved. also hazards and costs could be minimized, with considerable gain in quality improvement and maintenance.

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Magnesium Aircraft Wings

NAVY TRAINING PLANES have been using wings fabricated entirely from magnesium for more than a year, as a result of a design project on which Dow Chemical Company has been cooperating with the Navy since 1940. Thirty sets of wings, originally designed for the Navy's, SNJ-2 advanced trainer, built by North American, were ordered in 1942 after static tests and subsequent design changes. The wings have been in service since early 1943.

Tests of aluminum wings and those made of low carbon steel, stainless steel, plywood and other materials showed the magnesium wing the strongest, and showed it to be 14 percent lighter than the aluminum wing.

Meanwhile, N. H. Simpson and Paul R. Cutter, chief chemist and research chemist, respectively, of Consolidated Vultee's Fort Worth Division, have developed a finish known as CVAC No. 1 AC and the CVAC No. 1 DC process, which will be shared with other companies. Prior to development of the new finish the company had been using magnesium alloys sparingly because of their susceptibility to atmospheric corrosion, but since the finish became available, the metal is being used for dorsal fins, tails, castings, wing trailing edges, instruments panels, pilot seats and general furnishings. It can be used in new models for skin, formed ribs, control surfaces and stiffeners besides present applications.

The average fighting plane now uses about 1,000 lb. of magnesium alloys.

Patents Up in Air

SEN. HOMER T. BONE, Washington Democrat and head of the Senate's Patents Committee which conducted ex parte hearings on various proposals for patent law reform during 1942, resigned from the Senate in November, shortly before his term was to expire. Bone accepted a federal judgeship in the Pacific Northwest. In leaving the Senate without finishing the hearings, which were stopped late in 1942, allegedly to protect various large companies scheduled for examination, Bone failed to carry out a promise which he made at least twice, guaranteeing businessmen who had been investigated by his committee a chance to reply.

Bombsights Revealed

"MICKEY" is the Air Forces name for the radar eye which permits accurate bombing through cloud or smoke cover from thousands of feet in the air.

Emphasizing that the device is no match for the renowned Norden bombsight, from which the services recently removed a few of the wraps which have surrounded it for years, the Air Forces point out that, when used by a highly skilled operator, "Mickey" will find targets somewhat larger than the "pinpoint" variety with fantastic regularity through the thickest cloud cover. Even a layman can locate as obvious a target as a coastline, but the skilled operator can pick out specific buildings in a target area. One correspondent, reporting on "Mickey" from Italy, said the Gargano promontory on the Italian coastline became visible in the glass screen of the instrument, as plain as if it were being scanned on a map. The operator, having located a given area, can cut down the area shown, thus increasing details and enabling him to concentrate on small, specific targets.

The services disclosed that the Norden bombsight comes in two pieces, one the stabilizer which weighs about 30 lb. and would fit in a 7-in. tube, the other the sighting instrument which weighs about 60 lb. and measures 14 x 6 in. Cost is somewhat under $10,000 per sight, and production is now sufficient to equip every multi-motored Army and Navy bomber.

Capt. Frederick I. Entwhistle, U.S.N., was revealed as a co-developer of the Norden sight, which for years was kept so secret that repeated requests by the British and Russian governments for the instrument were denied and bombardier trainees were sworn to protect it with their lives. In revealing the mechanism to public display, it was disclosed that more than 2,000 parts are used in the sight. Earlier, an Army spokesman said that Germany and Japan would be unable to duplicate the sight on a mass basis, even if each nation had one in perfect working order, for more than two years.

Nazis Down to Stockpiles

GERMANY is now primarily dependent on stockpiles for the ferro-alloys it needs for continued war production, according to Foreign Economic Administrator Leo T. Crowley, who disclosed that the Nazis have now lost almost all their foreign sources.

Loss of Nikopol, the Balkans and Hungary, Crowley said, cut the German manganese supply from 350,000 tons (metal content) yearly to a maximum of 70,000 tons annually, or enough for an annual steel output of 7,000,000 tons, compared with Germany's 1943 output of 35,000,000 tons.

Stoppage of Turkish chrome shipments and virtual loss of all Balkans chrome, the report added, "has deprived Germany of practically all sources of chrome."

Under agreements with Portugal and Spain only "a small trickle" of tungsten reaches Germany, while the loss of France has further depleted sources.

Loss of Petsamo, Finland, and the liberation of Greece leaves the Nazis dependent for nickel upon a domestic production of 1,000 tons yearly.

Loss of Finland and the Balkans deprived the Germans of two-thirds of their limited molybdenum supply, which was about 650 tons in 1943. Norway is the principal source remaining, its output estimated at 200 tons yearly.

For cobalt, the Germans are dependent upon a domestic output of about 100 tons, having lost the 150 tons available last year from Finland.

In 1943, Germany produced about 1,000 tons of vanadium metal, of which almost all came from ores obtained in Lorraine, now unavailable to the Nazis.

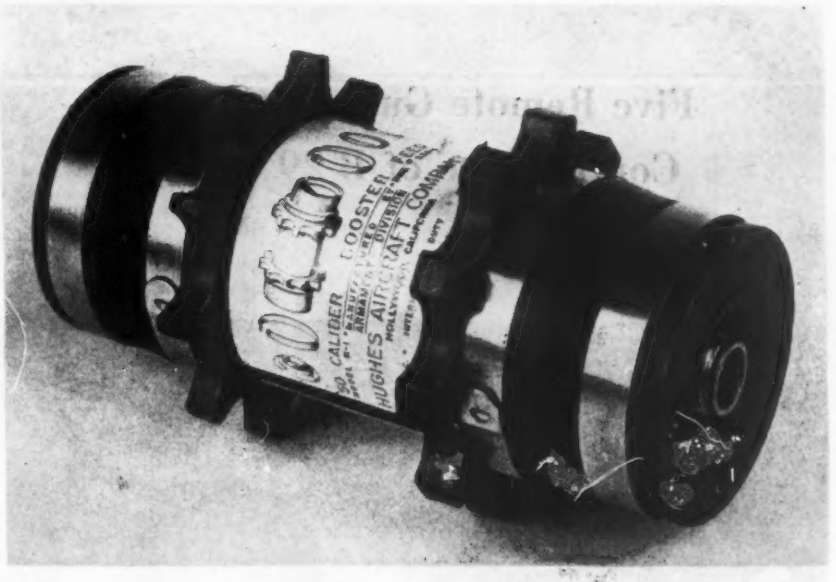
Ammunition Booster Has Shock-Absorber Between Motor and Drive

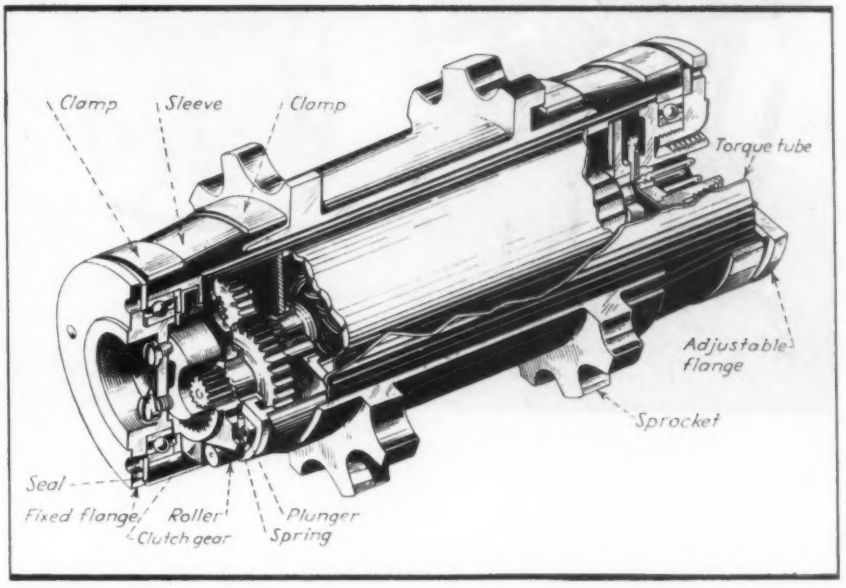
LOCATION and size of machine gun ammunition boxes presented a serious problem to the Army Air Force. Originally, ammunition boxes were attached directly to the guns and were of small capacity, requiring frequent changes under battle conditions. The Army Air Force desiring to increase the capacity of the boxes requested the Hughes Aircraft Company to study this problem.

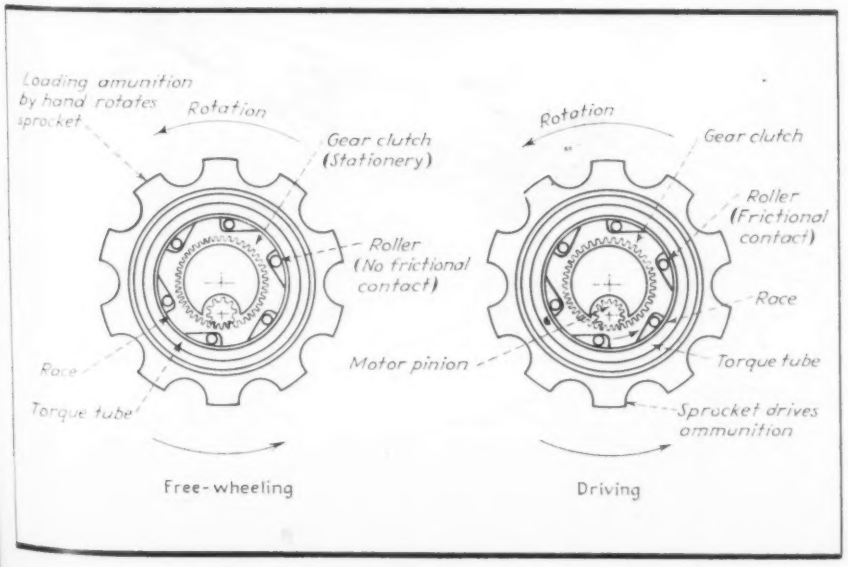
Tests were first made using ammunition boxes hung remotely from the gun and slightly above it for a gravity feed. This arrangement did not prove satisfactory as it limited the location as well as the size of the ammunition box.

To place the ammunition box below the gun required the development of a compact ammunition booster motor which could be mounted either in the ammunition box or directly on the side of the gun. Motor must operate at rated power between sea-level and 40,000 ft. altitude in temperatures from −65 deg. F. to +160 deg. F. and in an atmosphere containing dust and salt spray, and must absorb shock loads.

Resilient sleeves are capable of absorbing full torque of the motor. Sleeves are fastened by steel clamps to the outer ends of the sprocket sleeve assembly and to the torque tube race assembly. These resilient sleeves allow the motor to rotate torque tube sleeve assembly 36 deg., absorbing shock loads caused by starting and stopping and jerking of ammunition belt.

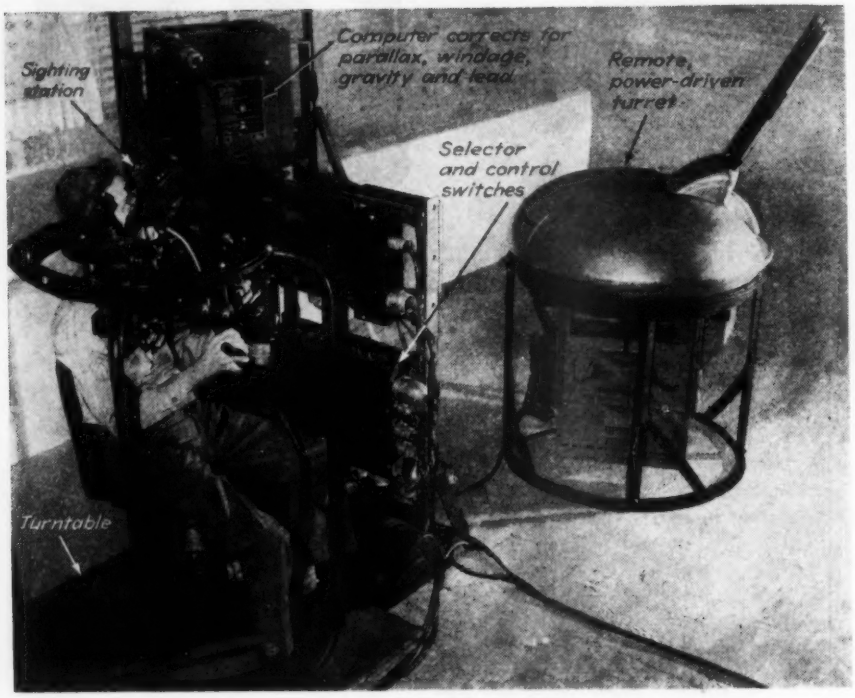






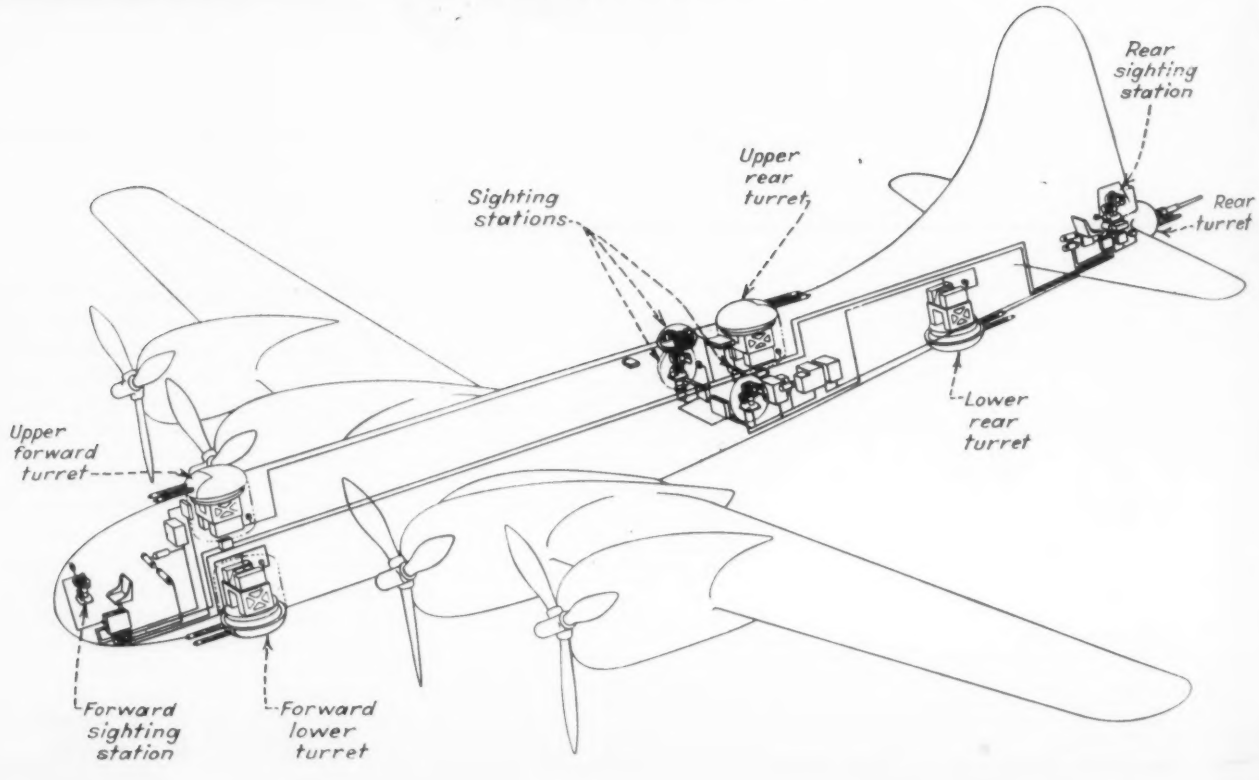
Free-wheeling device. The drive pinion of the motor drives the steel clutch gear in a counter-clockwise direction causing the steel rollers to engage frictionally the wedge-shaped sections between the clutch-gear and the torque tube and race assembly thereby driving the sprocket. When hand loading is required, pulling on the ammunition belt causes the torque tube and race to rotate in a counter-clockwise direction, releasing the rollers from frictional contact with the steel clutch gear, and allowing the sprocket wheel to free-wheel. Rotation from left-hand to right-hand and vice versa can be accomplished by reversing the clutch and changing the electrical contacts.

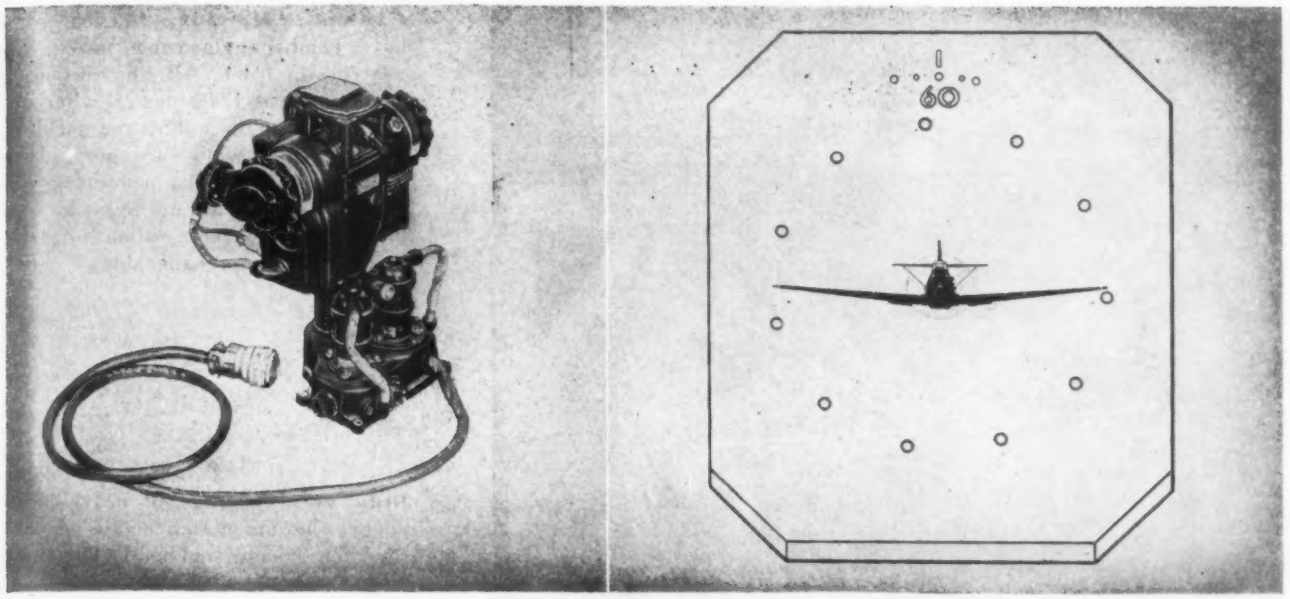
Five Remote Gunnery Stations Control Fire of B-29 Turrets



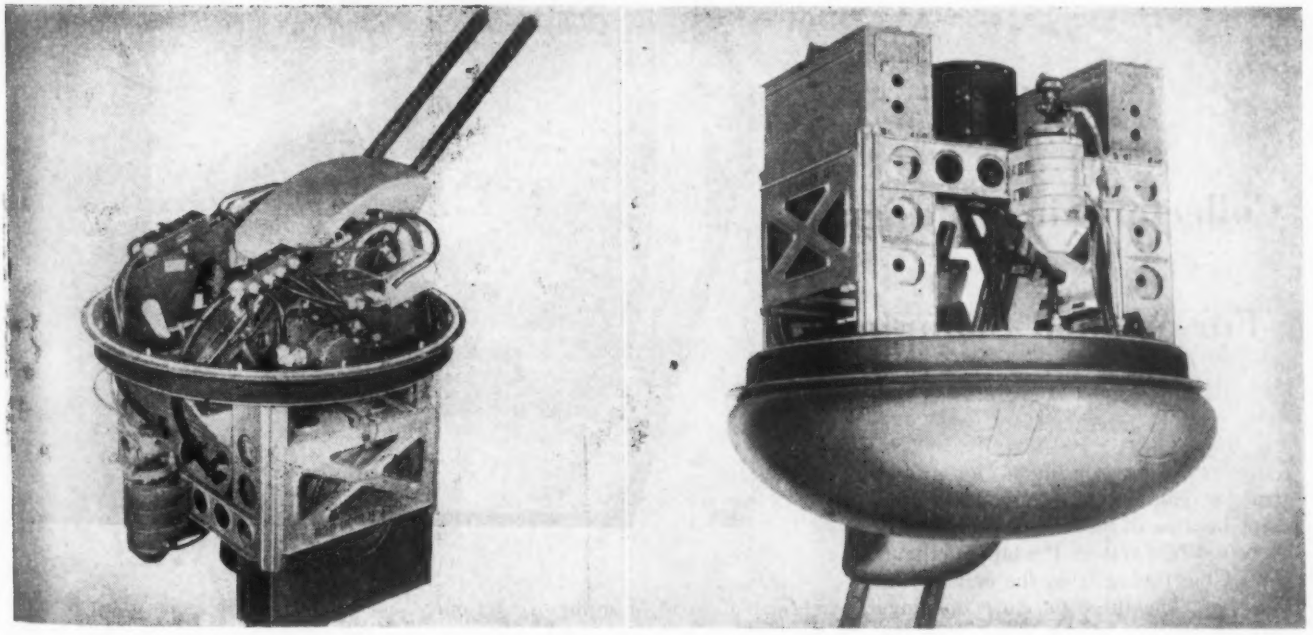
CONCENTRATED FIREPOWER, remotely controlled, is instantly available for the protection of the B-29 Superfortress against enemy fighters. Thirteen guns, located in five turrets, are electro-mechanically interconnected with five remote control stations. Any gunner can control one to three turrets, and more than 30 different combinations of turrets can be obtained through a selector switching arrangement. Through suitable combinations of Selsyns, Amplidynes and mechanical devices, traverse of the turret follows the traverse of the gunner-operated sight, with the additional feature that sighting errors caused by gravity, windage, parallax and lead of the enemy plane are automatically corrected by electrical computers included in the circuit.

Developed by General Electric engineers after study of tactical requirements and structural factors with Army Air Force and Boeing engineers, the central aerial gunnery system provides precision sighting, allows most strategic location of the guns, and reduces gunner fatigue. Armament is located in two forward upper and lower turrets for protection from nose attack, an upper rear turret to combat overhead attack, a lower rear turret to meet attacks from underneath, and a tail turret to protect the rear.

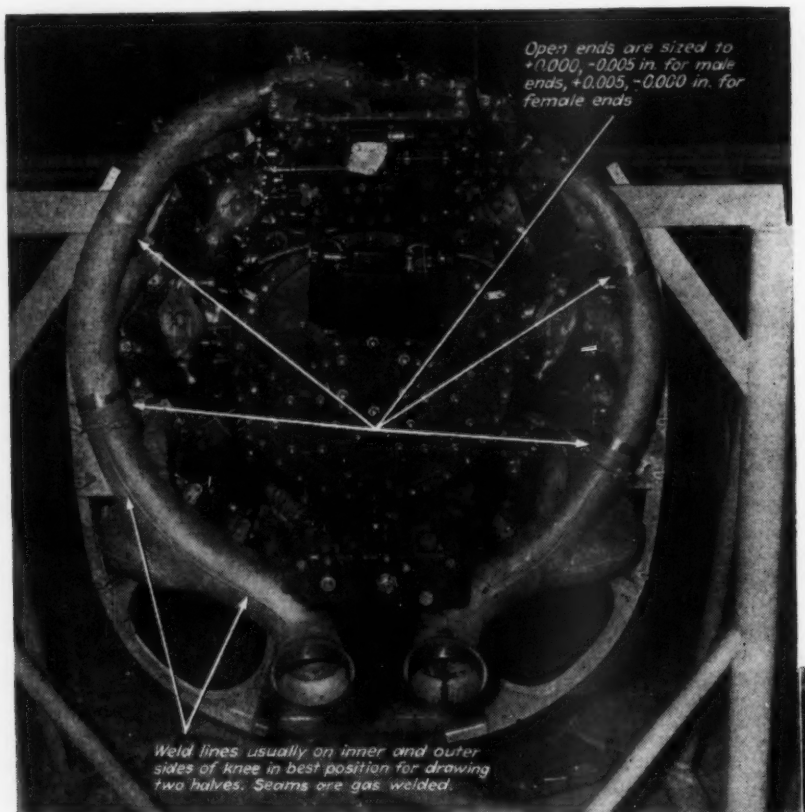




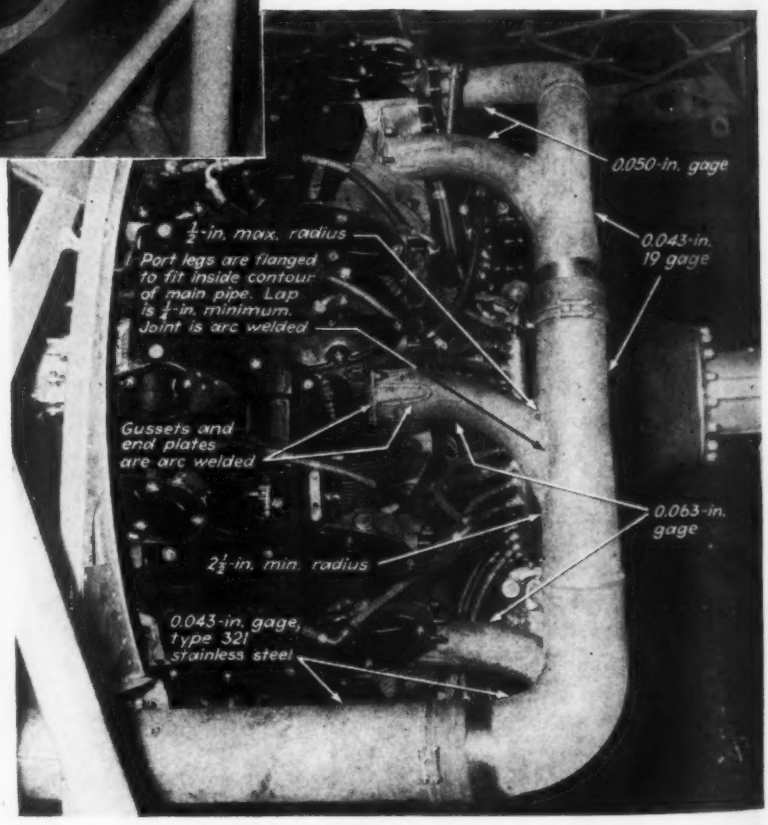
Sighting station through which gunner aims and with which he automatically determines range and lead factors. A spot of light is the aiming point. Around the sighting dot is a circle of red dots. Range is determined automatically as circle is adjusted by gunner to span the length of the target. Sun filters and a brightness control on the sighting light permit use in direct sunlight or darkness. Position indicators on the sight are electrically connected to a similar set of Selsyns on the turret. As the sight is moved, the indicators on the sight and the indicators on the turret compare the line of sight with the line of fire. If a difference exists, an electrical signal representing the difference between directions is fed into an electronic servo-amplifier, which in turn applies electric current to the field of an Amplidyne motor-generator. This generates a voltage which causes the turret drive motor to run in the proper direction until the position indicators signal that the guns are lined up with the sight.



Turrets rotate about a vertical axis. Guns are mounted in a saddle which permits rotation about a horizontal axis. Thus the guns can bear in any direction in more than a hemisphere. Automatic boosters, gun chargers and an air compressor are located in each turret. The electric boosters insure positive ammunition feed into each gun. The compressed air operates automatic gun chargers which fire the gun when the trigger on the sight is pressed, and eject duds when the gun refuses to fire. If five consecutive misfires occur, the device disconnects the gun from the circuit. Six electric motors operate each turret and point the guns. The armament system includes automatic fire interrupters that prevent the guns from firing at interfering elements on the plane itself and a device which elevates the guns slightly as they traverse past the sighting stations to prevent accidental shooting of the plane crew.


Open ends are sized to +0.000, -0.005 in. for male ends, +0.005, -0.000 in. for female ends
Weld lines usually on inner and outer sides of knee in best position for drawing two halves. Seams are gas welded.

Exhaust collector ring on rear of heavy bomber engine connects with a similar ring in front. All ring sections are heat-treated at 1,900 deg. F. after welding, quenched in water, and pickled to remove scale. Welds are sand blasted. Sections are then clamped in a special fixture to bring all openings to within $\frac{1}{32}$ in. of their true position so that all parts will be interchangeable.

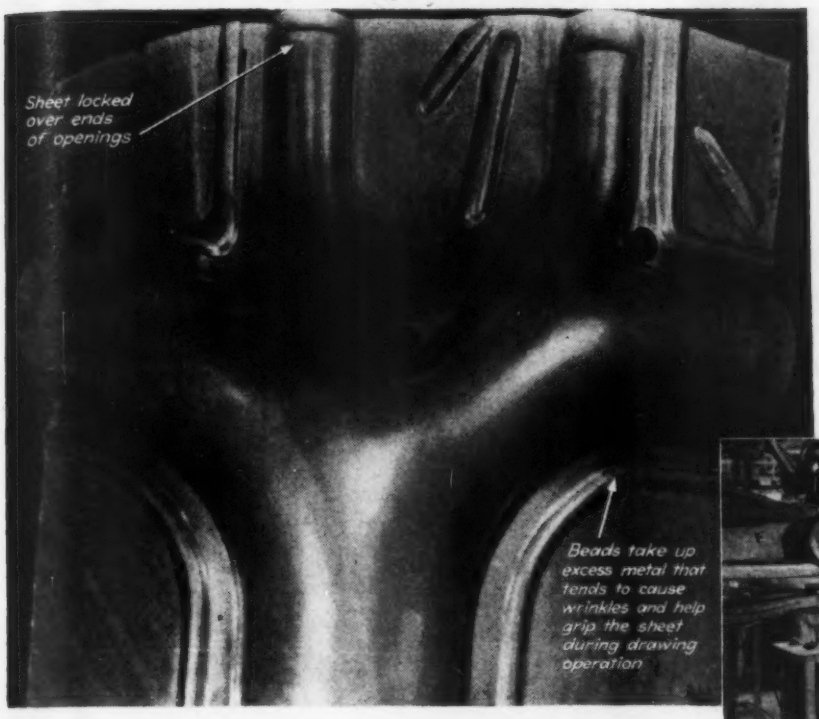

0.050-in. gage
½-in. max. radius
Port legs are flanged to fit inside contour of main pipe. Lap is ¼-in. minimum. Joint is arc welded
0.043-in. 19 gage
Gussets and end plates are arc welded
0.063-in. gage
2½-in. min. radius
0.043-in. gage, type 321 stainless steel

Side view at front of heavy bomber engine showing design details of collector ring sections and method of attachment to engine.

Complicated Collector Rings Designed For Welded Stampings

EXHAUST COLLECTOR RINGS for radial airplane engines have a complicated shape because of the serpentine contours of the exhaust system, the tapered diameter of the tubing from the ends to the tail stack, the three or more openings in each section of the rings, and the close dimensional tolerances required for interchangeability of parts and close-fitting joints. In spite of all these complications, such a structure can be made as an assembly of stampings with a minimum of welding, as demonstrated by the design shown here. Stamping and welding design was developed by American Central Manufacturing Company with production speed and economy as primary considerations. Basic dimensional specifications, supplied by Consolidated Vultee Aircraft Corporation, included the exact center locations of the engine ports, diameters of ports and all openings in ring sections, clamps and rings, as well as certain limitations as to tubing contours, location of reference points at the ends of each section of the exhaust system, and the specification of the types of joints and dimensional tolerances on their fit.

Type 321 stainless steel is used because of its greater resistance to intergranular corrosion, the common cause of failure in stainless steels when they are welded and used at high temperatures.

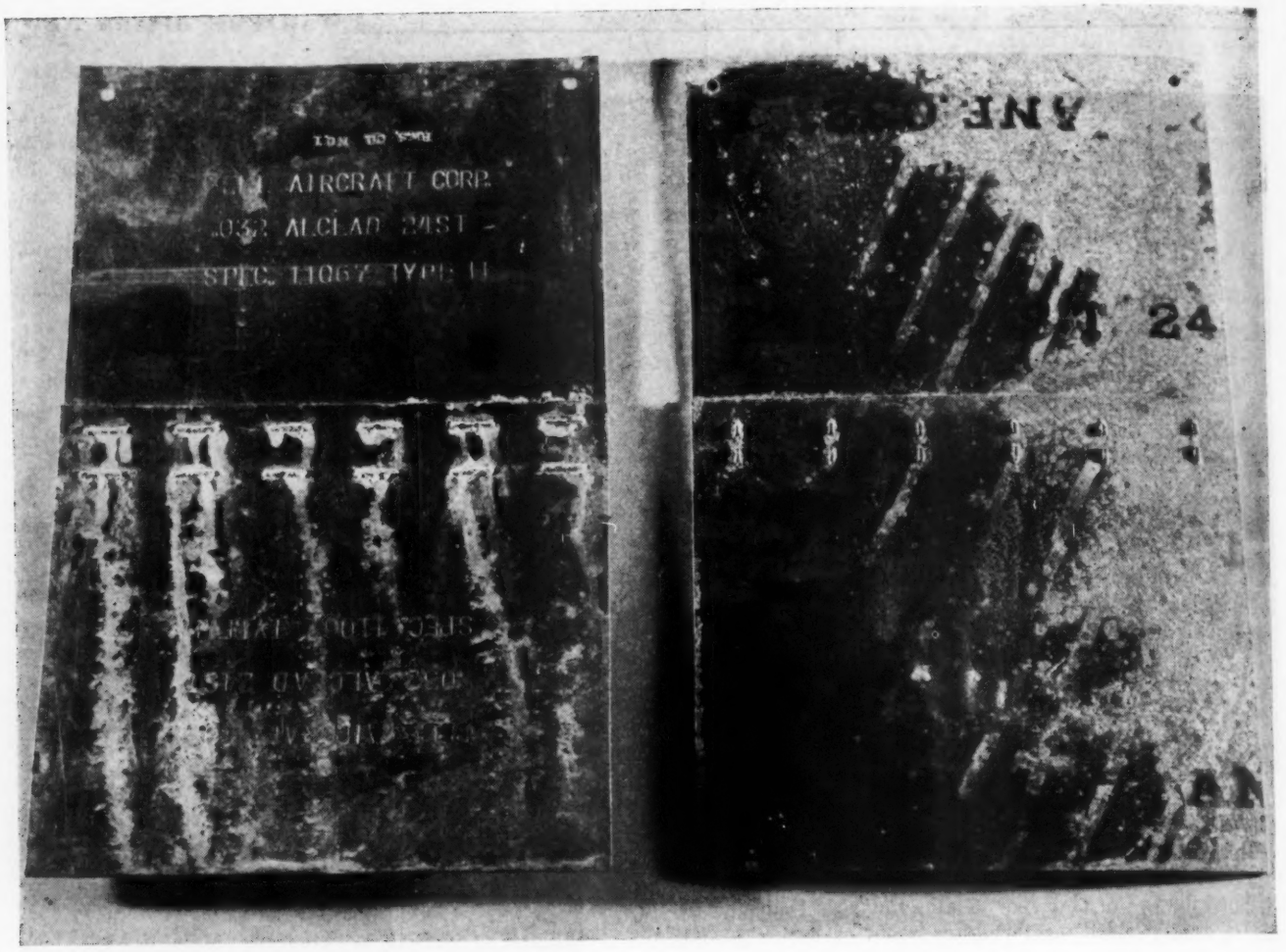

Sheet locked over ends of openings
Beads take up excess metal that tends to cause wrinkles and help grip the sheet during drawing operation

(Below) Outer half of a section of the B-24 exhaust collector ring with five openings. This section can be made in two parts because the legs are short and do not deviate greatly from a common plane. The inner half, with reversed over-all curvature, required innovations in die construction to prevent wrinkling, such as locking the sheet over the ends of all openings. This was done on two of the openings on the outer half also but proved to be unnecessary.

(Above) The two halves of collector ring sections have sharp radii of $\frac{1}{32}$ in. at the weld line produced by a restriking operation in the dies. They are held together in a specially designed fixture for tack spot welding the flash. Collector sections are gas welded together after removing flash.

Glass-Laminated Sheets Safeguard Superfortress Tanks

FLEXIBLE SHEETS of resin-impregnated fiberglas cloth serve as a protective lining in the fuel cell cavities built into the wings of the Boeing B-29 Superfortress. Because of high impact strength, the sheets prevent flowering of the metal walls when the fuel cell is struck by a bullet. Thus the rubber fuel cell cannot be torn by the jagged petals of such flowers. When damaged severely, the self-sealing material cannot close the hole. Unlike metal, the fiberglas-resin sheets will not flower.



Wire Stitched Lap Joints In Aluminum Alloy Sheet

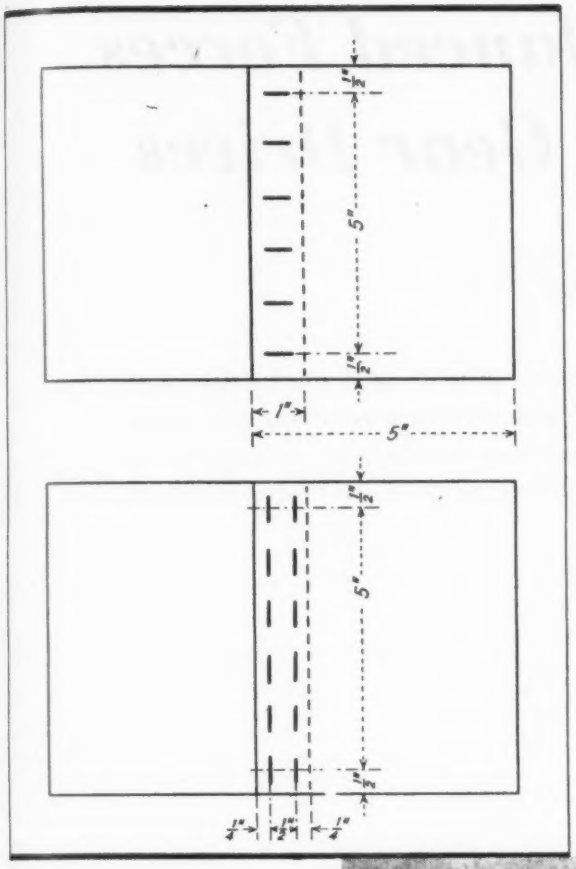
MacDONALD SILL
Section Chief of Laboratories, Bell Aircraft Corporation

Zinc-coated steel wire staple joints in aluminum sheet give satisfactory results in salt spray test for corrosion resistance, and in pull strength and vibration tests. Long service records also show wire stitching is suitable for many joints.

UTILIZATION of wire stitching or stapling for joining light sheet metals requires attention to service problems as well as determination of joint design for maximum strength. An important requirement is corrosion-resisting wire that keeps this property after being pushed through the sheet metal and bent into shape. Wire conforming to Specification AN-W-13 meets these requirements satisfactorily. Another is determination of the pattern of stapling and size of wire that give best results with respect to bearing strength of the sheet of various gages and materials, and pulling out or breaking of staples.

Investigation of the corrosion resistance of zinc-coated steel wire by subjecting stitched joints in 0.032-in. sheets of 24SO and 24SO Alclad, 24ST and 24ST Alclad, 52SO, and 2SHH aluminum to 700 hours of salt spray showed equally good results with all specimens. There was little or no indication of corrosion at the stitched joints. Wire used in this test was 0.048 in. dia. with 0.001 in. coat of zinc, produced by American Steel and Wire Company, and 0.048 in. Bethanized wire, produced by Bethlehem Steel Company.

Following this corrosion test the specimens were cut in 1-in. strips for vibra-

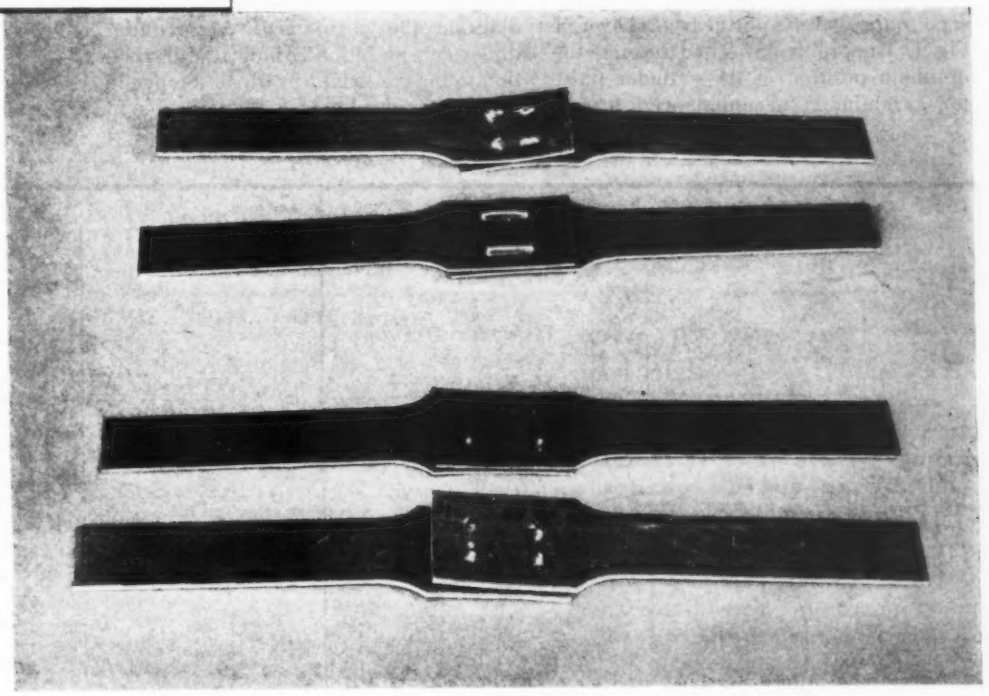


(Above) Dimensions of stitch-bonded aluminum sheet of four gages as prepared for salt spray test.

Table I — Average Ultimate Strengths Of Wire-Stitched Lap Joints in Aluminum Sheet

Material	Thickness, in.	Stitching Parallel to Direction of Pull — Ultimate Strength, lb.		Double Stitching Perpendicular to Direction of Pull — Ultimate Strength, lb.	
		Single ½" Staple 0.048" dia. Bethanised*	Two ⅜" Staples 0.048" dia. galvanized	½" Staple 0.001" Zn 0.048" dia.	⅜" Staple galvanized 0.048" dia.
24SO	0.025	—	285	—	347
24SO	0.032	280	414	482	431
24SO Alclad	0.032	283	—	519	—
24SO	0.040	—	543	—	528
24SO	0.051	—	505	—	692
24ST	0.025	—	654	—	531
24ST	0.032	435	737	891	755
24ST Alclad	0.032	442	—	812	—
24ST	0.040	—	805	—	831
52SO	0.032	278	—	586	—
2SHH	0.032	238	—	395	—

*After 700 hr. salt spray.



(Left) All stitch-bonded specimens had a good appearance after 700 hr. in salt spray. Specimens were cut into six parts for pull and vibration tests.

(Right) Stitch-bonded specimens after pull test. These specimens were not subjected to a corrosion test before being pulled.

tion and pull tests. Vibration tests were made on a DeForest fatigue tester of the vibrating reed type at the natural frequency of the specimen, 3,600 cycles per min. with maximum amplitude. The results of this test were considered good.

Pull tests indicated excellent strength characteristics of the joints. The wire used had a tensile strength of 290,000 lb. per sq. in. Table I gives the average results of pull tests of specimens both with and without previous corrosion tests. Six samples each were made of 24SO and 24ST aluminum of four gages using 0.048 in. dia. galvanized steel wire with two ⅜ in. staples parallel to the direction of pull and six with two staples at right angles to the direction of pull. In these tests the loads tended to straighten the hooked end of the staples but the failure of the sheet metal in bearing is even more pronounced.

Parts such as trailing edge sections, air ducts, and others having stitched joints have been in service several years, thus proving the design possibilities of this type of joint by its ability to withstand the variable conditions of service where both strength and corrosion resistance are required. Fast fabrication is an important advantage.

Analysis of Unbalanced Forces In Multicylinder Gear Drives

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Acrotorque Plant, Curtiss-Wright Corporation

Investigation of rotating and reciprocating forces present in a mechanism consisting of single cylinder units mounted around and driving a common spur gear. Test observations and oscillograph pictures confirm conclusions deduced from summations of moment and force equations referred to the center of the system.

AN ANALYSIS to determine where to place several single-acting cylinder reciprocating units, each with a driving pinion, around a common spur gear to obtain a minimum of unbalanced forces resulted in some interesting conclusions. All moving parts of the mechanism were in the same plane. The cylinder units could be mounted radially, tangentially or at intermediate angular positions, in reference to the driven spur gear as shown in Fig. 1. The problem was to determine the optimum position of the cylinder units for a minimum of unbalanced forces.

In making the analysis, the rotating unbalanced forces and the reciprocating unbalanced forces were considered as two different systems. Since rotating forces usually can be easily balanced by counterweights, they were considered before analyzing the reciprocating force system.

The forces acting on a rotating crank and their directions are shown diagrammatically in Fig. 2. Notice that in the diagram the position of the cylinder under consideration is indicated in relation to the No. 1 unit in which the piston is at its top dead center. In reference to Fig. 2 the legend for the symbols is

O = center of main output gear
A = angle between centerlines of consecutive cylinders, deg.
ψ = phase difference in timing, that is, when the piston of No. 1 cylinder is at top dead center the phase difference is the angle in degrees between the position of any other particular crank or eccentric and its position when at its own top dead center
θ = angle of rotation of the crank or eccentric from phase difference base line, deg.
F = centrifugal force caused by rotation of the crank or eccentric, lb.
e = eccentricity or crank radius, in.

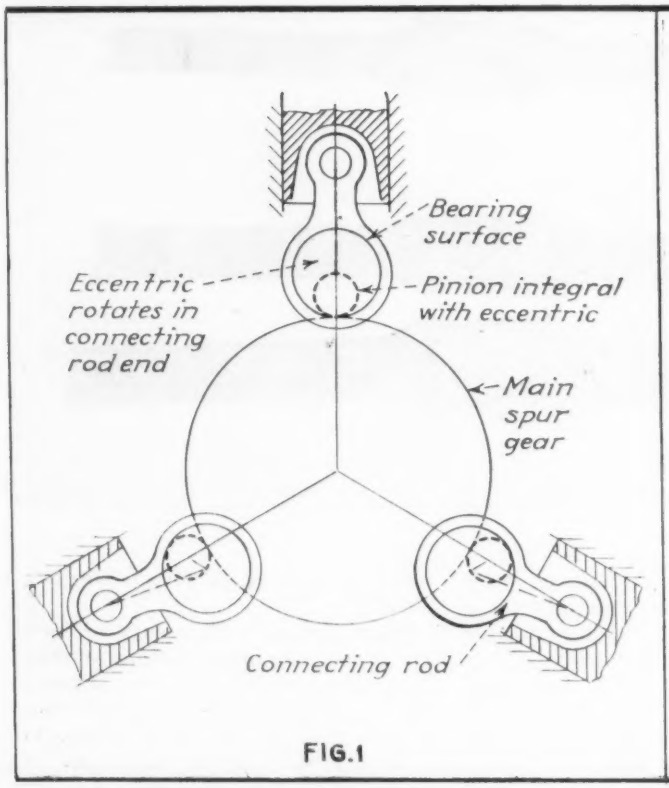


Fig. 1—Arrangement of three single reciprocating cylinder units to drive a central spur gear.

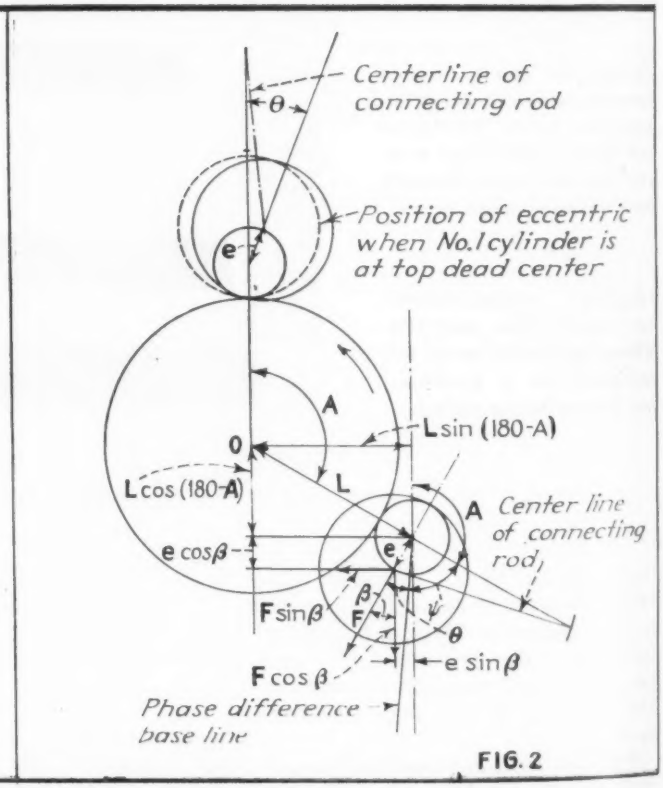


Fig. 2—Diagram of forces and their directions acting on a rotating crank or eccentric.

L = center distance between main spur gear and pinion of cylinder unit, in.
β = angle in deg. between direction of centrifugal force F and a vertical line drawn through the center of eccentric or crankpin center

To calculate the effects produced by the centrifugal force F, resolve this force into horizontal and vertical force components and take the moment of each about the center of the main spur gear, then

Moment M_h of the horizontal component of F about O

$$M_h = F \sin \beta [L \cos (180 - A) + e \cos \beta]$$

Moment M_v of the vertical component of F about O

$$M_v = F \cos \beta [L \sin (180 - A) - e \sin \beta]$$

Total moment M_t of centrifugal force F about O

$$M_t = M_h + M_v$$
$$= F \sin \beta [L \cos (180 - A) + e \cos \beta)] + F \cos \beta [L \sin (180 - A) - e \sin \beta)]$$
$$= F L \sin (A - \beta) \quad (1)$$

From Fig. 2 it is seen that

$$\beta = A + \psi + \theta - 180 \quad (2)$$

Substituting Equation (2) in Equation (1)

$$M_t = FL \sin (180 - \psi - \theta)$$
$$= FL \sin (\psi + \theta) \quad (3)$$

The total moment of rotating forces produced by one unit about the center of the system, therefore, is expressed by Equation (3). The total moment for n units is

$$M_t = FL \sum_{n-1}^{n-n} \sin (\psi_n + \theta) \quad (4)$$

Expressing Equation (4) in the form

$$M_t = FL \sum_{n-1}^{n-n} \sin (\psi_n + \theta)$$

then expanding

$$M_t = FL \left[\cos \theta \sum_{n-1}^{n-n} \sin \psi_n + \sin \theta \sum_{n-1}^{n-n} \cos \psi_n \right] \quad (5)$$

When the units are evenly spaced around the main spur gear and timed such that

$$A = (360/n) \quad (6a)$$

$$\psi_1 = 360/n; \psi_2 = 2\,(360/n); \ldots\ldots$$
$$\psi n = n\,(360/n) \quad (6b)$$

the summation of the sines and cosines in Equation (5) will be zero, therefore, under these conditions there will be no unbalanced moment about the center O. The diagrams of Fig. 3 illustrate this condition, the vectors shown by solid lines represent the centrifugal force F at each eccentric or crank when Equations (6a) and (6b) are satisfied. The vectors shown by dotted lines are centrifugal forces which arise when the timing does not agree with Equation (6b). The solid vectors add up to zero moments and to zero X and Y forces. The dotted vectors add up to unbalanced resultant moments and to finite X and Y forces.

By the same method as used in evaluating the total moment of the centrifugal eccentric forces, expressions for the horizontal and vertical forces are obtained.

$$H_t = \sum_{n-1}^{n-n} F \sin \beta$$
$$= F \sum_{n-1}^{n-n} \sin (A + \psi_n + \theta - 180)$$
$$= F \left[\cos \theta \sum_{n-1}^{n-n} \sin (A + \psi_n - 180) + \sin \theta \sum_{n-1}^{n-n} \cos (A + \psi_n - 180) \right] \quad (7)$$

$$V_t = \sum_{n-1}^{n-n} F \cos \beta$$
$$= F \sum_{n-1}^{n-n} \cos (A + \psi_n + \theta - 180)$$
$$= F \left[\cos \theta \sum_{n-1}^{n-n} \cos (A + \psi_n - 180) - \sin \theta \sum_{n-1}^{n-n} \sin (A + \psi_n - 180) \right] \quad (8)$$

Again when the conditions of Equations (6a) and (6b) are fulfilled, the summation of the sines and cosines in Equations (7) and (8) will be zero and there will be no unbalanced horizontal and vertical forces about the center of the main spur gear.

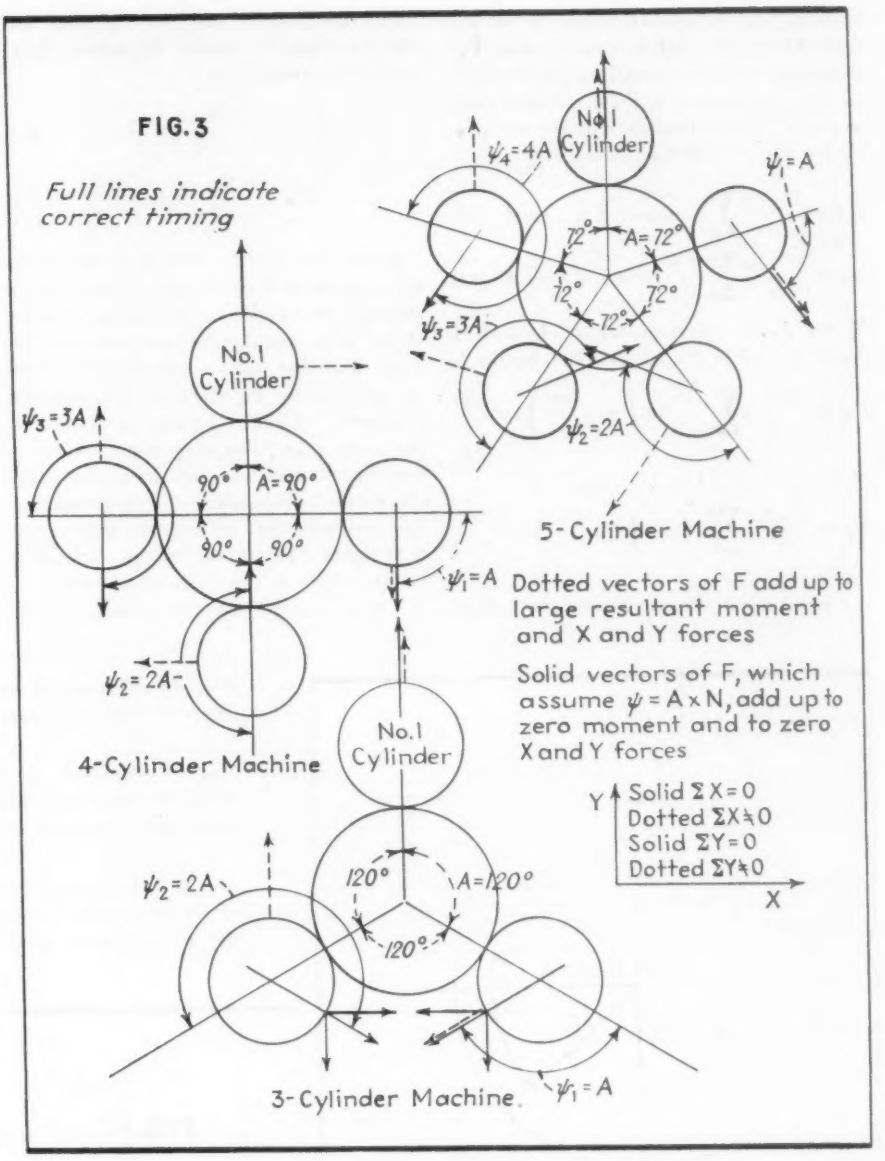


Fig. 3—Vector diagrams of centrifugal forces set up by rotation of eccentrics in three, four and five cylinder machines. Dash lines indicate incorrect timing.

Reciprocating Forces

In considering the reciprocating forces, first take the arrangement shown in Fig. 4 in which a cylinder is placed radially with its center line intersecting at the center O. The reciprocating force acts along the center line of the cylinder. The magnitude R of the reciprocating force for one cylinder, taking W_R as the weight of the reciprocating parts in one unit and ω as the angular speed of the crank of eccentric in radians, taking into consideration only the first harmonic, is

$$R = \frac{W_R e \omega^2}{g} \cos (\theta + \psi) \quad (9)$$

With the reciprocating force passing

through the center O, there is no moment about the center of the system. For n cylinders the summations of the horizontal components and the vertical components of the resultants of the reciprocating forces will therefore be

$$H_R = \frac{W_R e\omega^2}{g} \sum_{n-1}^{n-n} \cos(\theta + \psi_n) \sin A \quad (10)$$

$$V_R = \frac{W_R e\omega^2}{g} \sum_{n-1}^{n-n} \cos(\theta + \psi_n) \cos A \quad (11)$$

When ψ_1 is taken equal to A, and A equal to $360/n$ Equation (10) becomes

$$H_R = \frac{W_R e\omega^2}{g} \sum_{n-1}^{n-n} \cos\left(\theta + \frac{360}{n}\right) \sin \frac{360}{n} \quad (12)$$

and Equation (11) becomes

$$V_R = \frac{W_R e\omega^2}{g} \sum_{n-1}^{n-n} \cos\left(\theta + \frac{360}{n}\right) \cos \frac{360}{n} \quad (13)$$

Again when the conditions of Equations (6*a*) and (6*b*) are fulfilled and the summations made, Equations (11) and (13) reduce to

$$H_R = -\frac{n W_R e\omega^2}{2g} \sin \theta \quad (14)$$

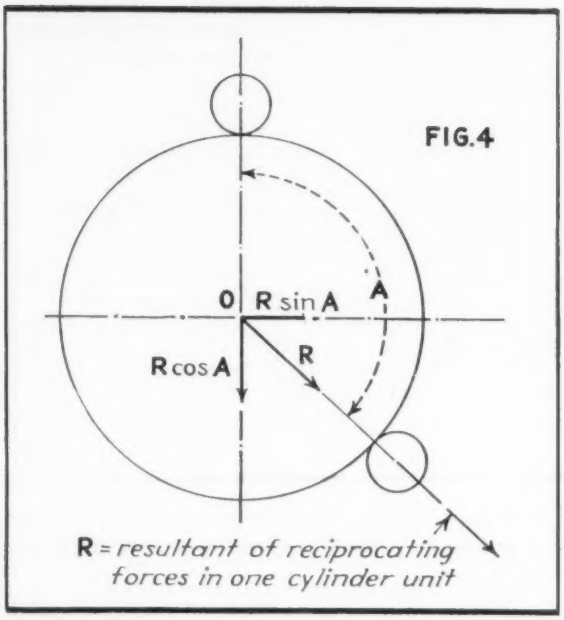
$$V_R = \frac{n W_R e\omega^2}{2g} \cos \theta \quad (15)$$

Forces H_R and V_R, which are the same as in a radial type reciprocating engine, cannot be easily balanced as usually there is a speed reduction between the units and the power output gear. This in turn causes a difference between the frequency of the unbalance and that of the main gear. The only place for counterweights would be at the main gear, since the discussion of the rotating forces shows that no independent counterweights can be placed on the units because they will nullify each other.

There is only one way to have a system of this type completely balanced. It consists of two systems of three one-cylinder units, the systems being timed 180 deg. out of phase; or any two identical systems timed 180 deg. out of phase, as in Fig. 5, which illustrates a balanced 6 cylinder arrangement.

If the pistons are moving on lines tangential to the main gear, a different system of forces results as shown in Fig. 6. In this case the summation of the moments about the center O will involve sine and cosine functions in the first power only. The sum of the moments will therefore be zero. The summation of the vertical and horizontal components indicates that there is the same amount of unbalance as when the cylinders are radial about the main gear. This shows that the inclination of the cylinders does not affect the amount of unbalance.

With a bevel gear system as shown in



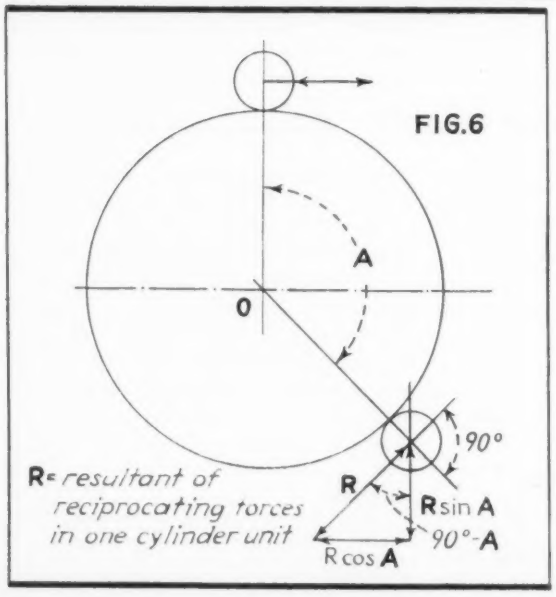


Fig. 4—Horizontal and vertical components of the resultant of reciprocating forces in one radial cylinder unit.

Fig. 5—Method of balancing a six cylinder machine by arranging two systems, each composed of three cylinders, in opposition to each other.

Fig. 6—Horizontal and vertical components of the resultant of reciprocating forces in one cylinder unit which is tangential to the main gear.

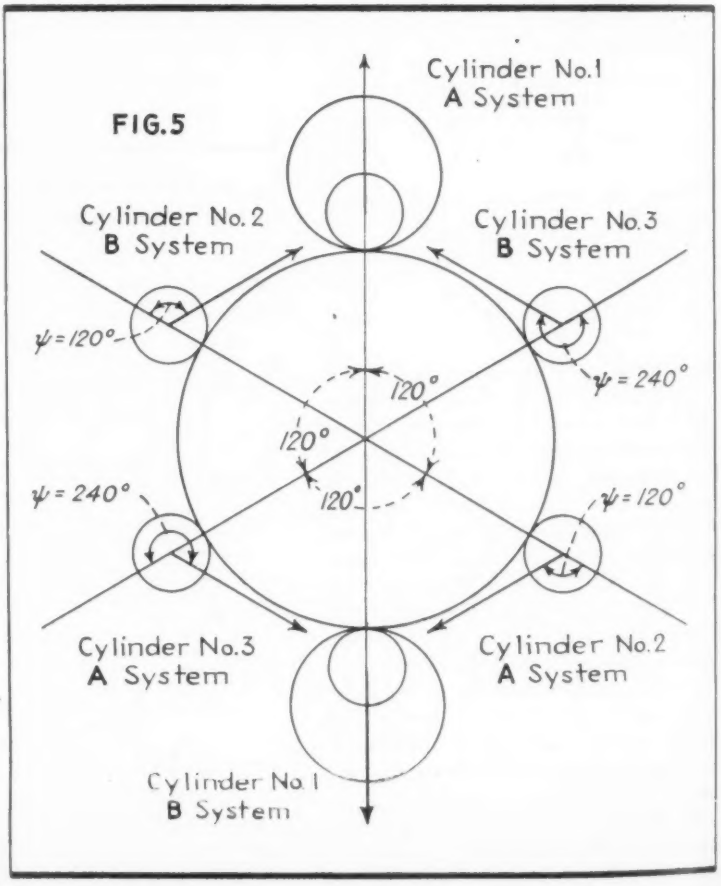


Fig. 7 the problem of balancing is complicated because of the connection between the units and the main gear.

In the course of the investigation a spur gear system was tested which consisted of reciprocating hydraulic motors having circular eccentrics instead of cranks. The motors were geared to the main spur gear through spur pinions. All motors were connected to the same pressure manifold. Oscillograph pictures, Fig. 8, gave identical patterns for a system without counterweights and for one in which each unit was separately balanced, and substantiated the following conclusions:

1. No counterweights are necessary to balance the rotating parts of mechanisms, which are similar to that analyzed in this discussion, provided that the cylinders are properly timed and spaced.

2. With units placed radially with respect to the main output gear, their total unbalance is the same as that of a radial engine having the same number of cylinders.

3. With radially placed units the reciprocating forces cannot be balanced by individual counterweights.

4. Radially placed units can be balanced by arranging two identical systems 180 deg. out of phase, with all units in the same plane.

5. Any inclination of the cylinders in relation to the main output gear does not affect the amount of unbalance in the system.

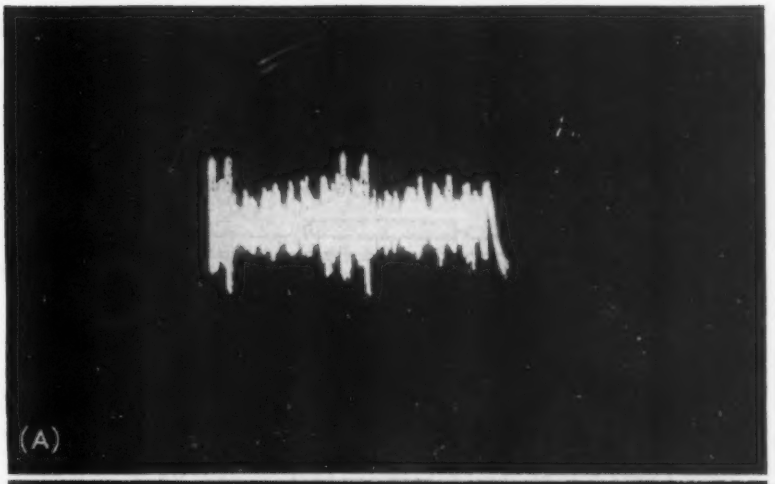


Fig. 8—Oscillograph patterns for a multicylinder gear drive system. (A) For 980 r.p.m. of output gear and 2,450 r.p.m. of driving units. (B) For 1,260 r.p.m. of output gear and 3,150 r.p.m. of driving units.

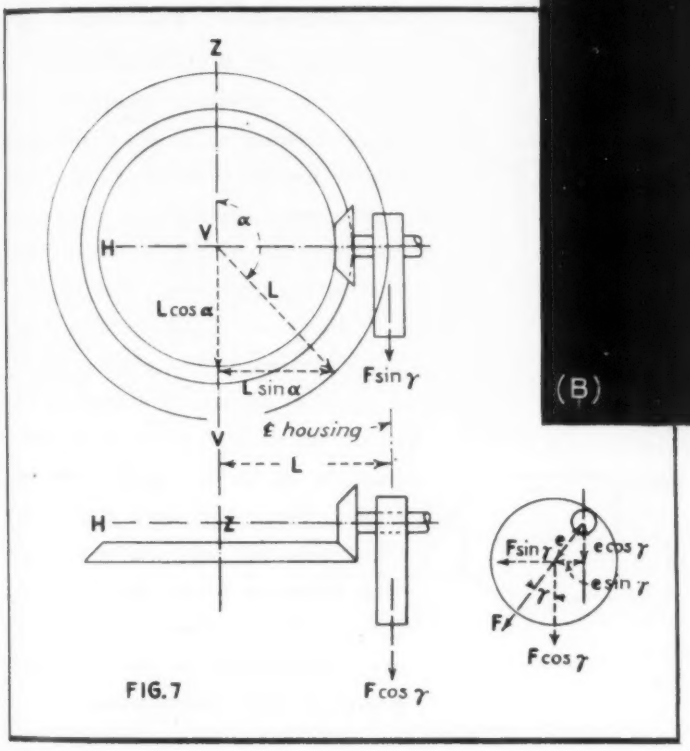


FIG. 7

Fig. 7—Schematic arrangement of a bevel gear system in which the rotating elements are in different planes.

Alcohol as an Engine Fuel

In studies made by the National Bureau of Standards of substitute fuels for possible use where petroleum is not readily available, engines have been operated on alcohol, both of conventional grade and in mixtures with as much as 66 percent water. The results emphasize the fact that the horsepower of an engine is fixed by the amount of air the engine gets, rather than the amount of fuel. With 190-proof alcohol a given engine develops more horsepower by several percent than with gasoline because when the alcohol vaporizes in the manifold it cools the air more than does the gasoline, thus permitting a greater weight of air to enter the cylinders.

Although engines can be operated with very low proof alcohols, there are various disadvantages which include: The amounts of fuel used are so great that carburetor connections, jets, fuel lines, fuel pumps and tanks would have to be increased in size; large amounts of water collect in the engine crankcase; and spark plugs become moist and fail to fire at low throttle. Spark settings must be changed. Fuel consumption of the low-proof alcohols is double that for high-test alcohol, even when based only on alcohol content.

AUTOMATIC FEED MECHANISMS

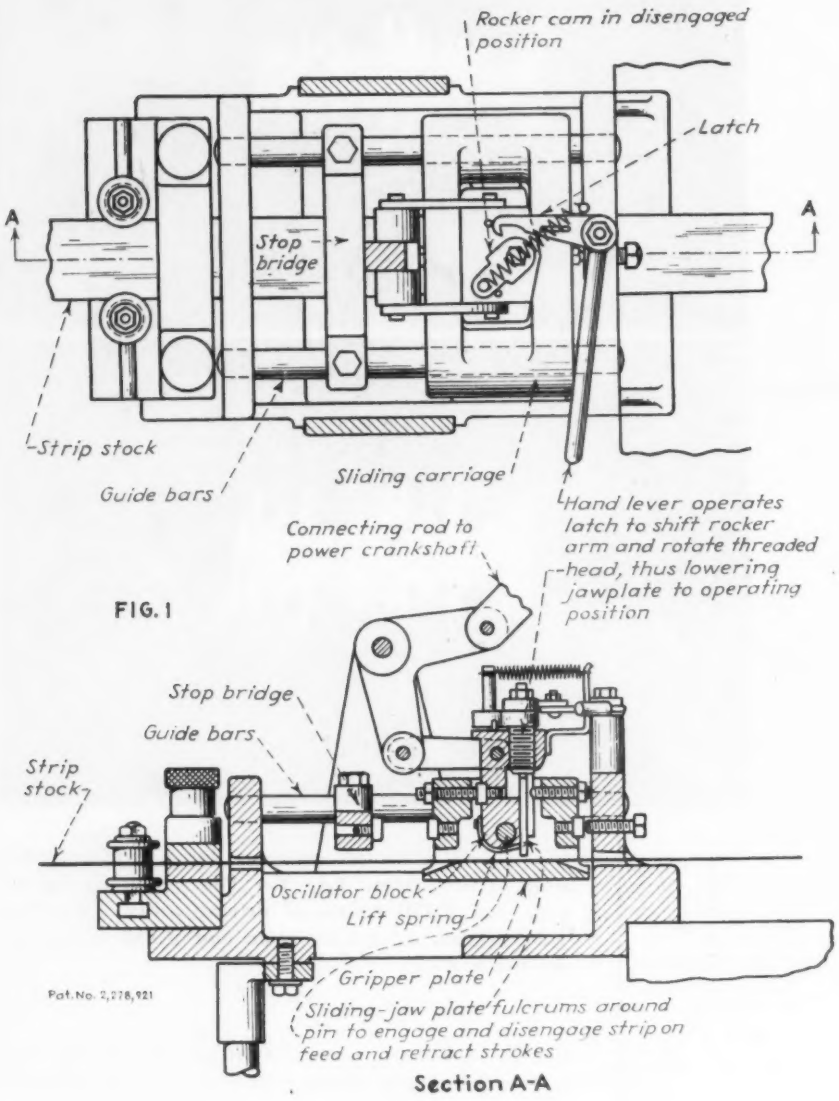
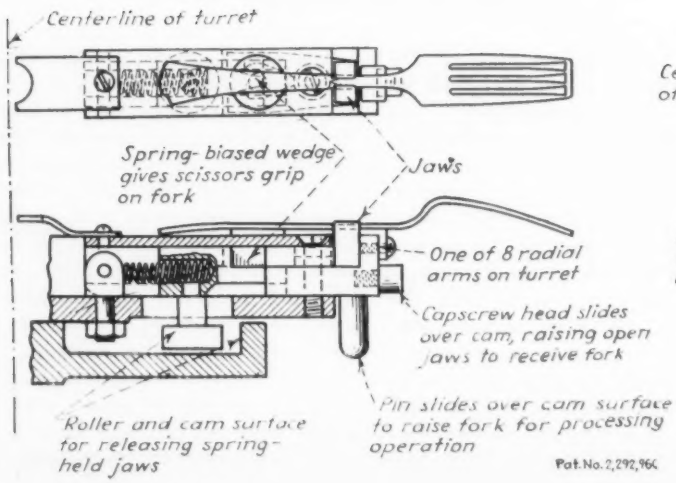


FIG. 1

Design of feed mechanisms for automatic or semi-automatic machines depends largely upon such factors as size, shape, and character of materials or parts being fed into a machine, and upon the type of operations to be performed. Feed mechanisms may be merely conveyors, may give positive guidance in many instances, or may include tight holding devices if the parts are subjected to processing operations while being fed through a machine. One of the functions of feed mechanism is to extract single pieces from a stack or unassorted supply of stock or, if the stock is a continuous strip of steel, roll of paper, long bar, and the like, to maintain intermittent motion between processing operations. All of these conditions are illustrated in the accompanying feed mechanisms.


Centerline of turret
Spring-biased wedge gives scissors grip on fork
Jaws
One of 8 radial arms on turret
Capscrew head slides over cam, raising open jaws to receive fork
Roller and cam surface for releasing spring-held jaws
Pin slides over cam surface to raise fork for processing operation
Pat. No. 2,292,964

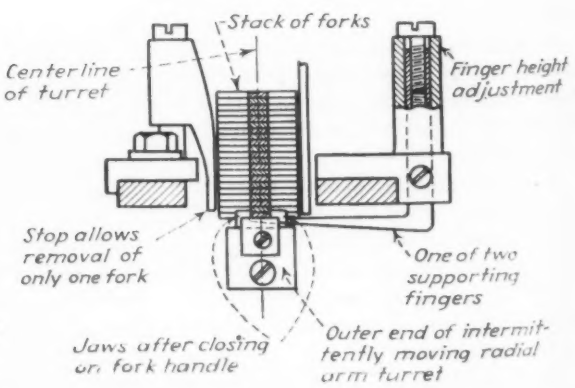

Stack of forks
Centerline of turret
Finger height adjustment
Stop allows removal of only one fork
One of two supporting fingers
Jaws after closing on fork handle
Outer end of intermittently moving radial arm turret

FIG. 2

FOR VARIOUS MATERIALS

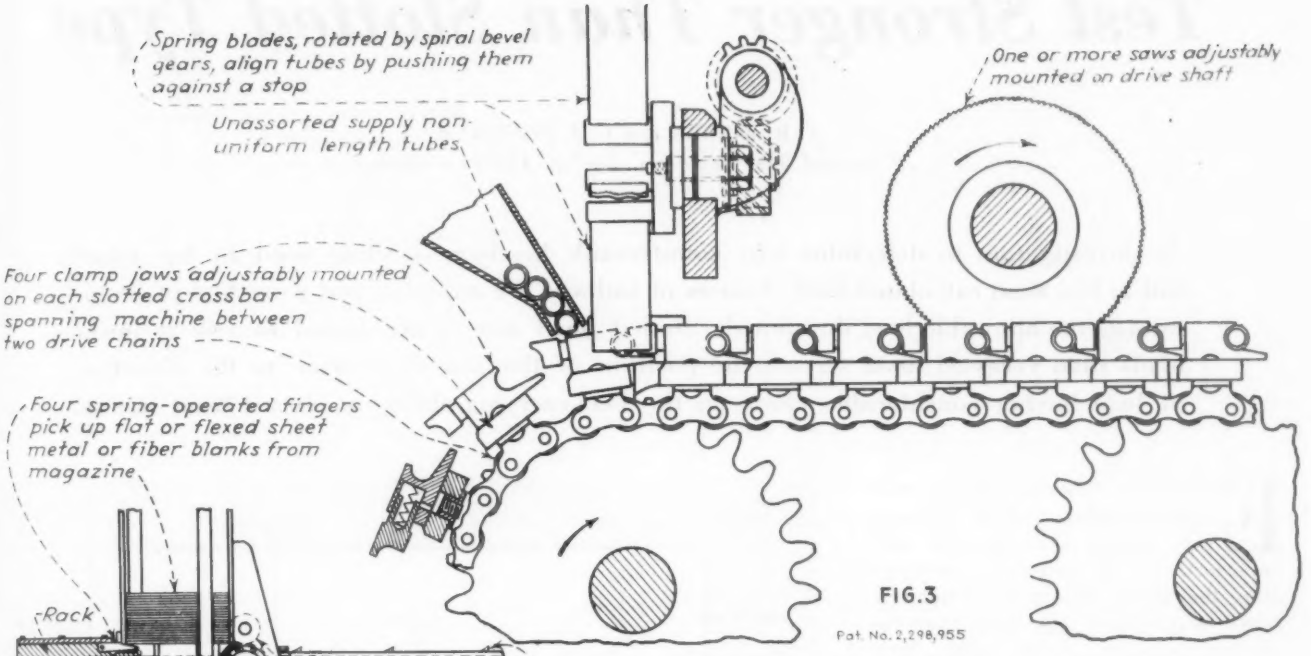

Spring blades, rotated by spiral bevel gears, align tubes by pushing them against a stop
Unassorted supply non-uniform length tubes
One or more saws adjustably mounted on drive shaft
Four clamp jaws adjustably mounted on each slotted crossbar spanning machine between two drive chains
Four spring-operated fingers pick up flat or flexed sheet metal or fiber blanks from magazine

FIG.3

Pat. No. 2,298,955

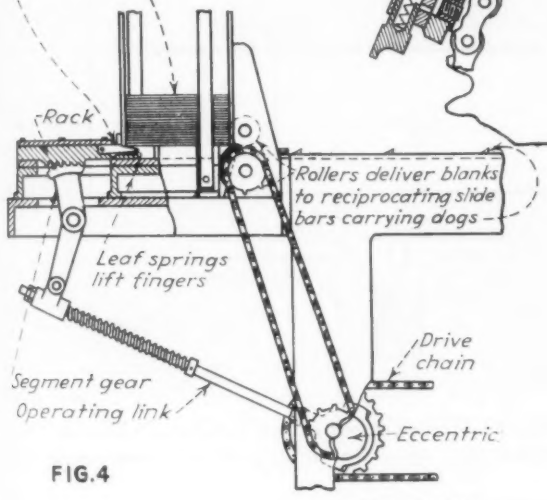
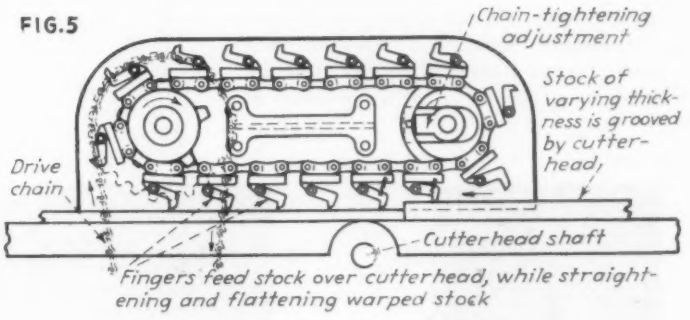


FIG.4

Pat. No. 2,270,871

FIG.5


Chain-tightening adjustment
Stock of varying thickness is grooved by cutterhead
Drive chain
Cutterhead shaft
Fingers feed stock over cutterhead, while straightening and flattening warped stock

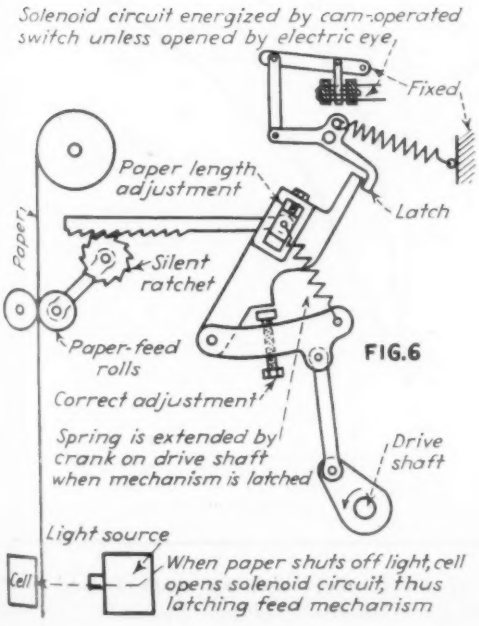

Solenoid circuit energized by cam-operated switch unless opened by electric eye
Fixed
Paper length adjustment
Latch
Paper
Silent ratchet
Paper-feed rolls
Correct adjustment
Spring is extended by crank on drive shaft when mechanism is latched
Drive shaft
Light source
Cell
When paper shuts off light, cell opens solenoid circuit, thus latching feed mechanism

FIG.6

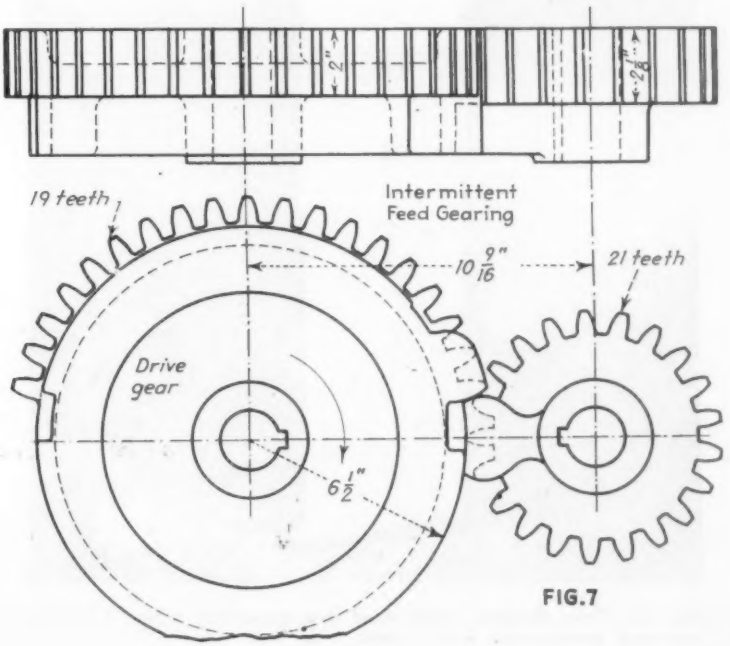


FIG.7

Screws With Recessed Heads Test Stronger Than Slotted Type

T. R. RIEBEN *and* C. J. SPENGLER
Structural Test Engineers, Boeing Aircraft Company

An investigation to determine why countersunk headscrews when used in lap joints fail at less than calculated load. Causes of failures are analyzed and a method of determining the allowable load developed. Slotted head screws are found to fail at lower loads than recessed head screws, the position of the slot in relation to the direction of load having considerable effect on the load-carrying ability of slotted head screws.

EARLY in 1940 the Boeing Aircraft Company began exploratory design work on the B-29 Superfortress. In order to minimize drag, the design required countersunk rivets, screws and butt joints on the exterior surface. There was little technical information available to guide the engineers in the failure of countersunk screws. It was discovered, during preliminary tests of a gasoline tank door, that countersunk screws although loaded in shear, failed in tension at

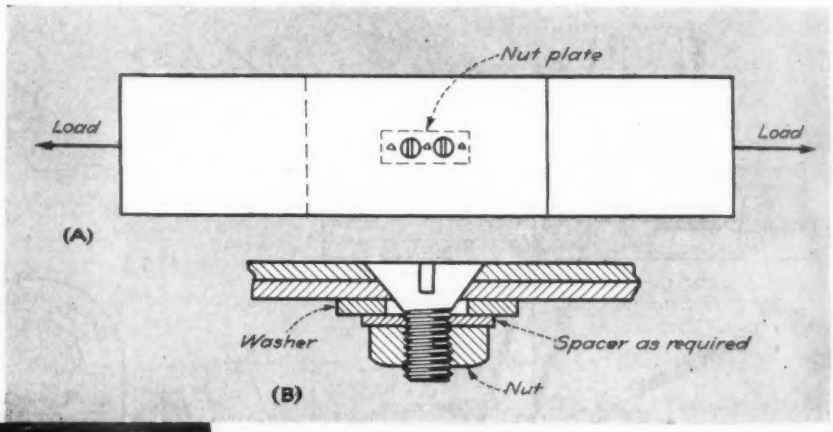


Fig. 1—Arrangement of test specimen showing a nut-plate (A) or a nut and washer arrangement (B)

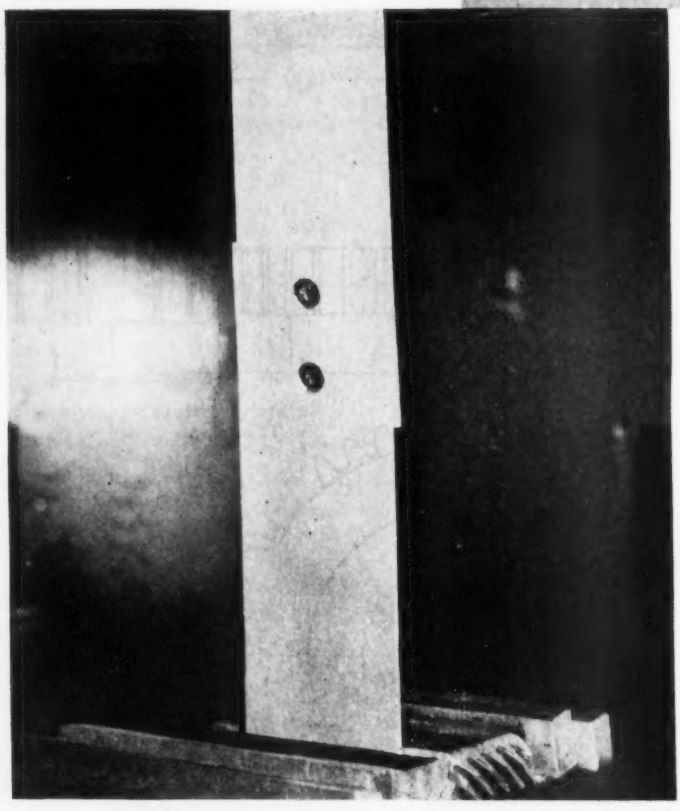


Fig. 2—Test showing failure of bearing sheet when Phillips recessed headscrews were used.

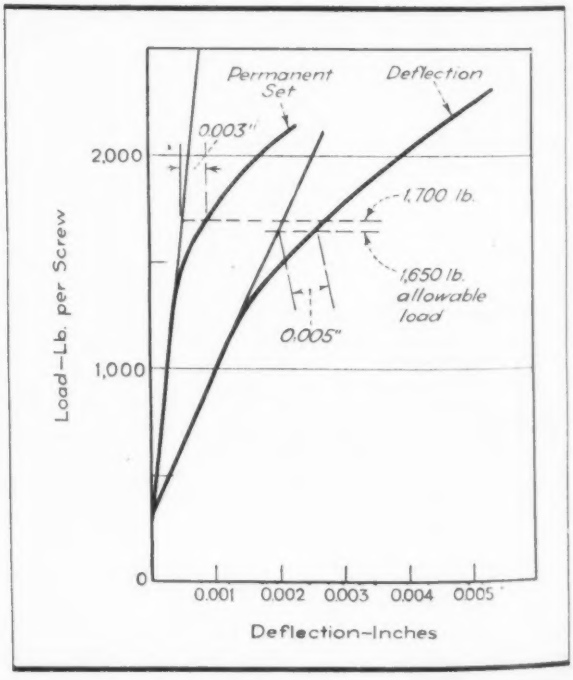


Fig. 3—Typical curves showing method used to determine the allowable load per screw.

loads considerably less than the rated loads. For this reason a thorough laboratory investigation was undertaken to determine the allowable loads for countersunk screw joints.

A test procedure was arranged to simulate the conditions of the door joint screw failure. The specimens, all of 0.072 24ST aluminum, were made as shown in Fig. 1, and the test set-up is shown in Fig. 2. All screws to be tested were of the 82 deg. countersunk type of 24ST aluminum or steel, and head forms were either full slot or Phillips type recess. Nuts were plain, castle or self-locking nut-plates, washers being used under all plain and castle nuts.

Tests were then made for various countersunk head screw and nut combinations. For each test, curves were plotted of load per screw versus deflection and permanent set. A typical curve is shown in Fig. 3. From these curves it was possible to select the allowable screw load. In determining the allowable screw load, two limitations were considered reasonable:

1. Average of the loads where the deviation of the deflection curve from its straight line portion was 0.005 inches.

2. Average of the loads where the deviation of the permanent set curve from its straight line portion was 0.003 inches.

The allowable screw load was then determined by either 1 or 2, whichever gave the lower value. The straight line portion of the curve is arrived at through a combination of engineering judgment and factual data. The combination of test points that give the most reasonable picture of specimen elastic action, disregarding initial "settling" deflections, determines the straight line.

The results of this series of tests are given in Table I. These indicate that the location of the screw slot in relation to the direction of load is important. In the test of the ¼ in. 24ST aluminum screws it can be seen that the ultimate strength of 800 lb. for the screw with slot normal to the direction of the load, is less than its ultimate

Table I—Test Results of Screw-Nut Combinations in Lap Joints

Screw Size	Screw Material	Nut Type	Screw Head	Average Ultimate Lb. per Screw	Allowable Shear Load Lb. per Screw	Type Failure
3/16	Steel	Plain (Steel)	Phillips	2,124	1,195	Bearing sheet
¼	24ST	Castle (24ST)	Full Slot (slot normal to load)	800		Head failed through slot
¼	24ST	Castle (24ST)	Full Slot (slot parallel to load)	1,480	870	Head failed through slot
¼	Steel	Nutplate (Dural)	Phillips	1,985	1,275	Bearing sheet
¼	24ST	Castle (24ST)	Phillips	1,125	1,038	Shear of threads in nut
¼	Steel	Nutplate (Steel)	Phillips	4,522	1,625	Bearing failure
5/16	24ST	Plain (24ST)	Full Slot (slot parallel to load)	2,170	1,250	Head failed through slot

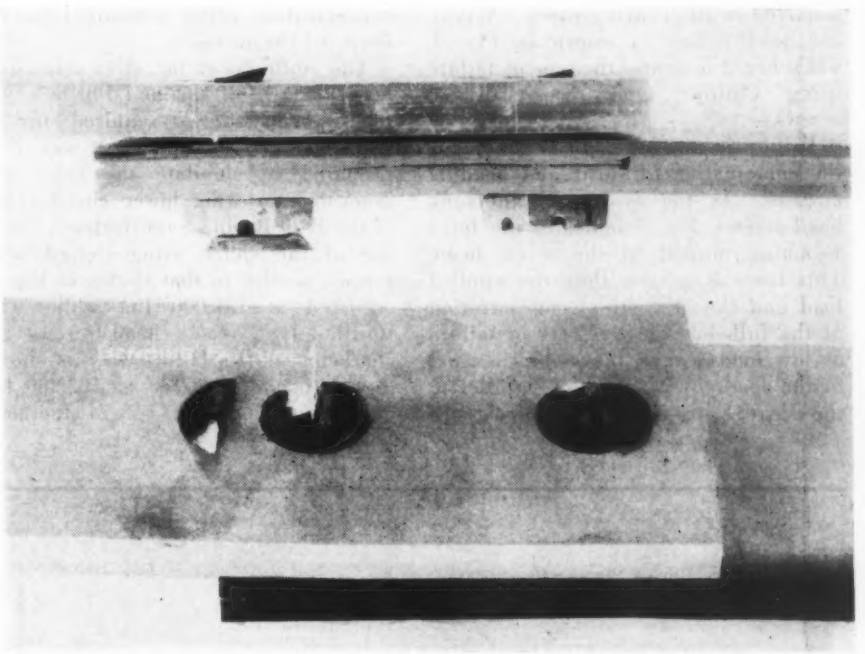


Fig. 4—Test specimen showing failure of slotted headscrew through the head slot, which are normal to direction of the applied load.

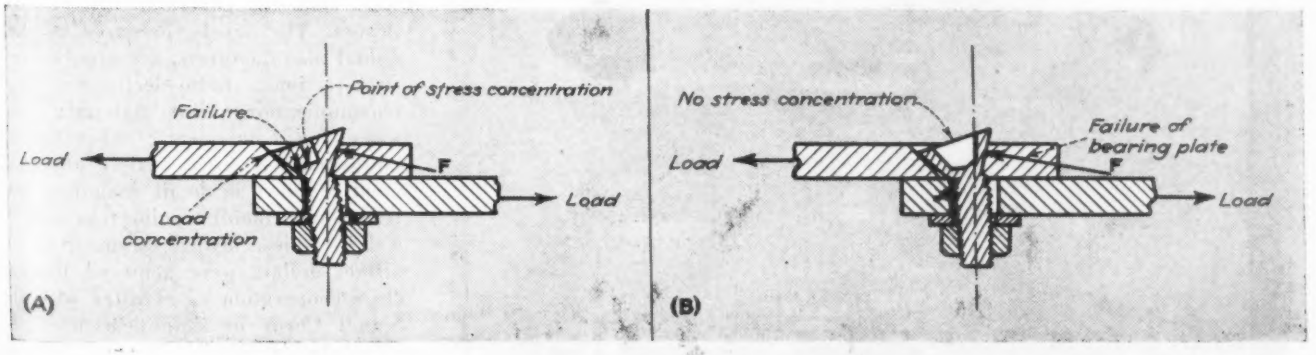


Fig. 5—Failure through stress concentration of a slotted headscrew with slot normal to the load is shown in (A). Failure of the bearing sheet when Phillips recessed head screws are used is shown in (B).

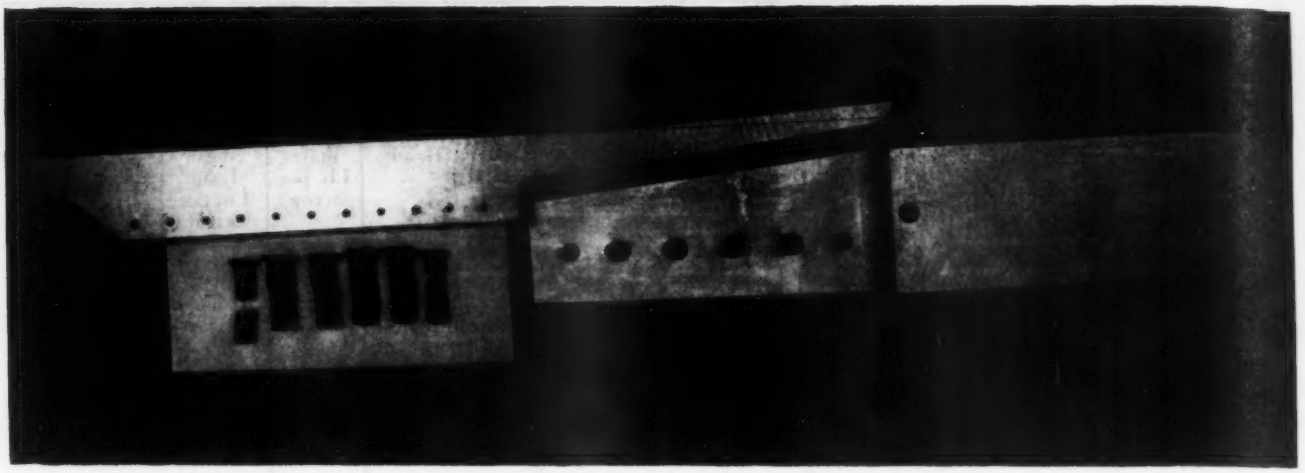


Fig. 6—Failure of Phillips head screws in the shear splice of a wing spar.

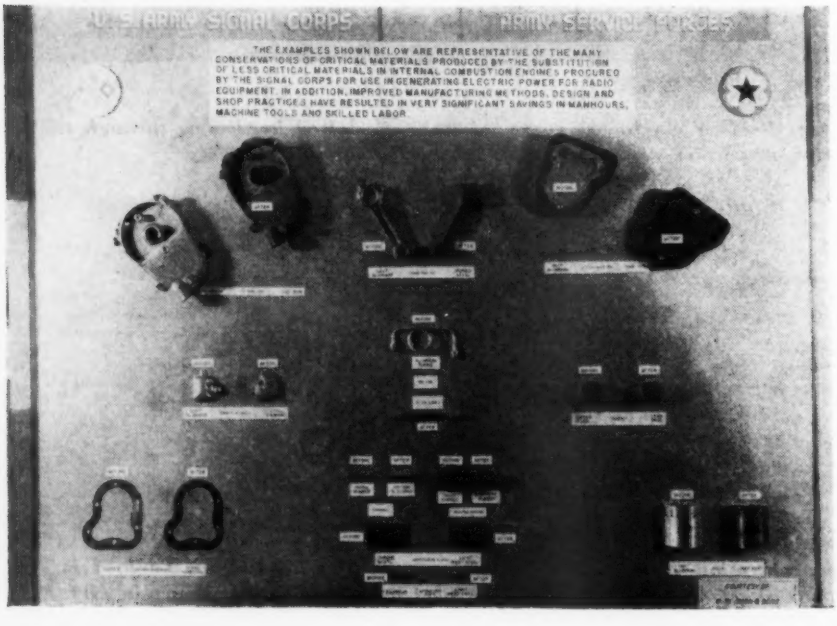
strength of 1,480 lb. when the slot is parallel to the direction of load. It is interesting to note that in the case of all full-slot screws the failure occurred in the head slot, while in the case of Phillips type recess head screws failure occurred in the bearing sheet. A typical head failure is shown in Fig. 4, while Fig. 2 indicates the type of failure using Phillips type recessed head screws.

Failure in any lap joint is caused by the combination of shear and bending stresses. In the case of countersunk head screws, Fig. 5 indicates the force F acting normal to the screw head. This force is greater than the applied load and thus the stress concentration of the full-slot screw results in failure at low loads, when the slot is normal to the load. With the slot parallel to the load, stress concentration still occurs but of much less magnitude and the concentration is divided between both sides of the screw head. The recess of the Phillips type head screw is cold forged giving greater strength through controlled grain flow, stress concentration being minimized by the shape of the recess.

The difference in allowable load between the full slot and Phillips type recess head screws required further investigation. A new test was then prepared to simulate the rear spar inner-to-outer wing lower chord splice of the B-29 Boeing Superfortress. Failure of the splice using slotted head screws, similar to that shown in Fig. 4, occurred at 131,000 lb., while with Phillips type recess head screws the character of the failure was as shown in Fig. 6 and occurred at 162,200 lb., giving an increase of 24 percent.

It is therefore recommended that whenever a designer must use countersunk head screws, to obtain the greatest allowable load in a lap joint, recessed head screws should be used. If recessed head screws are not available and full-slot screws must be employed it is advisable that the slot be placed parallel to the direction of the applied load.

This problem is by no means as simple as this article might indicate. The strength of a bolt in shear is influenced by pattern, sheet gage, and support from adjacent structure, and the allowables quoted herein are obviously applicable to only one combination of the above variables. Many additional tests are being made and when more complete data is available, this information will be prepared by Boeing engineers for PRODUCT ENGINEERING.


THE EXAMPLES SHOWN BELOW ARE REPRESENTATIVE OF THE MANY CONSERVATIONS OF CRITICAL MATERIALS PRODUCED BY THE SUBSTITUTION OF LESS CRITICAL MATERIALS IN INTERNAL COMBUSTION ENGINES PROCURED BY THE SIGNAL CORPS FOR USE IN GENERATING ELECTRIC POWER FOR RADIO EQUIPMENT. IN ADDITION, IMPROVED MANUFACTURING METHODS, DESIGN AND SHOP PRACTICES HAVE RESULTED IN VERY SIGNIFICANT SAVINGS IN MANHOURS, MACHINE TOOLS AND SKILLED LABOR.

ECONOMIES IN MATERIALS, manpower and manufacturing facilities in the production of communication equipment are graphically demonstrated in a new exhibit sponsored by the U. S. Army Signal Corps. This display, typical of 55 in the exhibit, illustrates savings made in generator drive engine design. The panels, prepared by individual manufacturers, are grouped into five sections: radio-electronics; wire communications; line material; processes and components; miscellaneous equipment. A great variety of equipment is shown in detail, including field telephones, mobile radio transmitters, walkie-talkies. Savings estimated at one billion dollars were achieved through close cooperation of industry with the Signal Corps in simplification of designs, standardization of parts, and improvements in production methods. Exhibit is now being shown in Chicago.

Electrical Equipment Design To Meet Aircraft Requirements

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Engineering Division, Equipment Laboratory, Wright Field

Requirements of and developments in military aircraft wiring systems, electric controls, electrical loads, and electronic controls are discussed to show why further progress is needed in the design of aircraft electrical accessories. This article concludes a discussion started last month on the influence of aircraft design on electrical equipment developments.

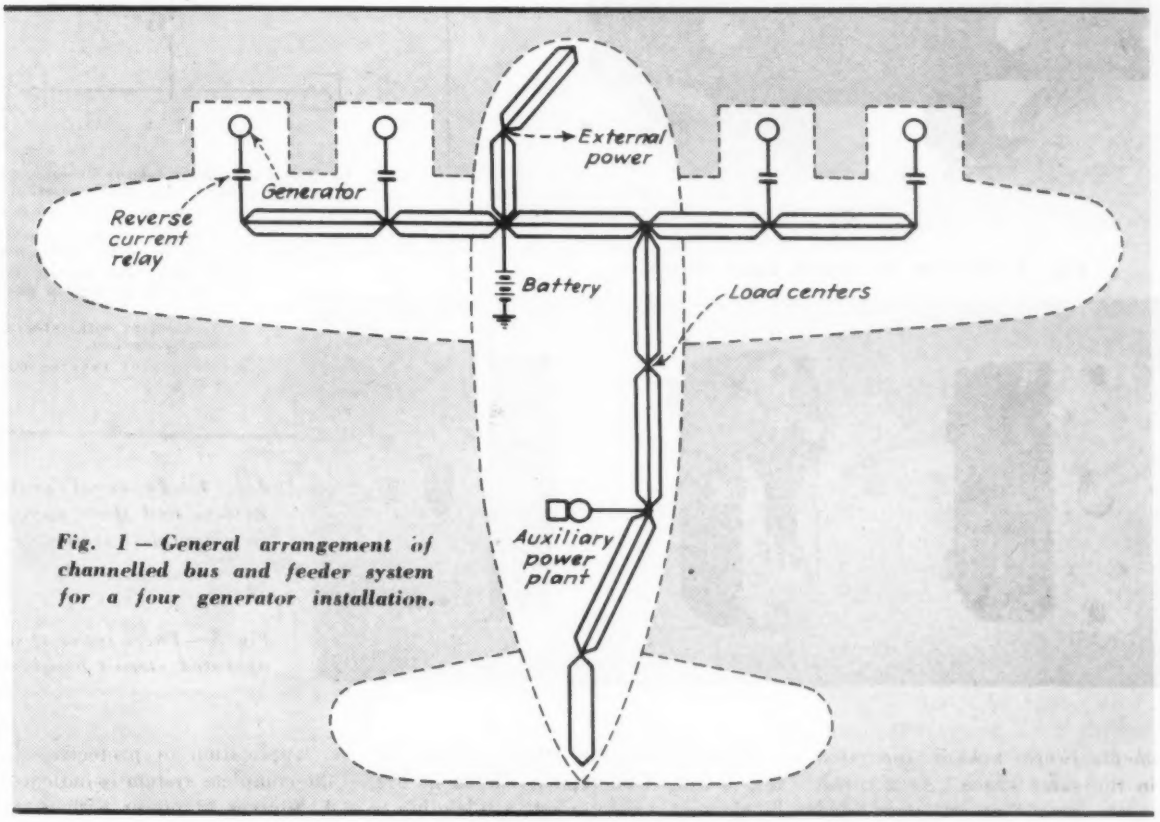


Fig. 1 — General arrangement of channelled bus and feeder system for a four generator installation.

IN multi-engine aircraft, the wiring and distribution system resembles a miniature public utility network. Further, many similar problems are encountered. In military aircraft continuity of service must be maintained at a minimum weight, and concessions must be made to vulnerability. The system must be of such design that a bullet or a piece of flak will do the least possible damage. To accomplish this, it is advisable:

1. To connect all generators, the battery and auxiliary power unit to a common interconnecting network system.

2. To connect bus points by channel feeder circuits which are divided into at least three paths.

3. To protect individual circuits as near the feeder network as possible.

4. To build protection into each separate piece of equipment.

A simple diagram of a wiring system is shown in Fig 1. The division of a circuit into three paths caused little increase in weight, because small conductors will cool better than large ones. If the system voltage could be increased to a point where conductor heating instead of voltage regulation was the primary consideration, weight could be saved by using multi-channel feeder circuits.

Control equipment is needed to transfer power from the bus and feeder network to the individual circuits. This is the function of three types of equipment: Switches, circuit breakers, and relays or magnetic contactors.

Space and precedent have influenced the design of switches and circuit breakers. Years ago, a panel space of 2x¾ in. was needed for a 10 amp. switch. As greater ratings were needed there was never any concession in size. All

Fig. 2—Group of typical toggle-actuated switches for aircraft.

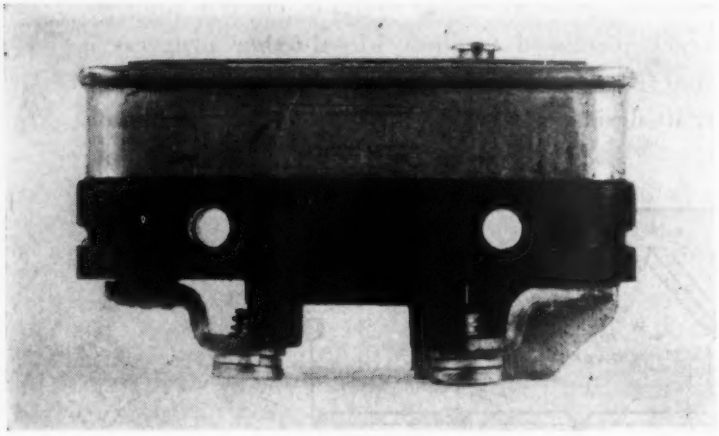
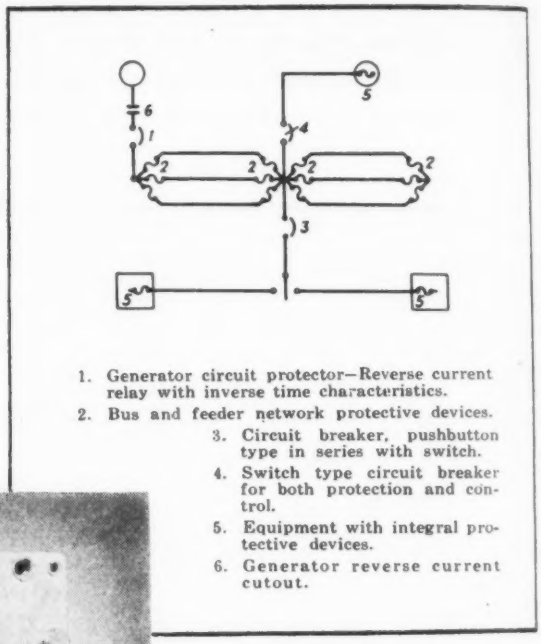


Fig. 3—Typical low-travel limit switch.



1. Generator circuit protector—Reverse current relay with inverse time characteristics.
2. Bus and feeder network protective devices.
3. Circuit breaker, pushbutton type in series with switch.
4. Switch type circuit breaker for both protection and control.
5. Equipment with integral protective devices.
6. Generator reverse current cutout.

Fig. 4—Types of protective devices and their application in a complete system.

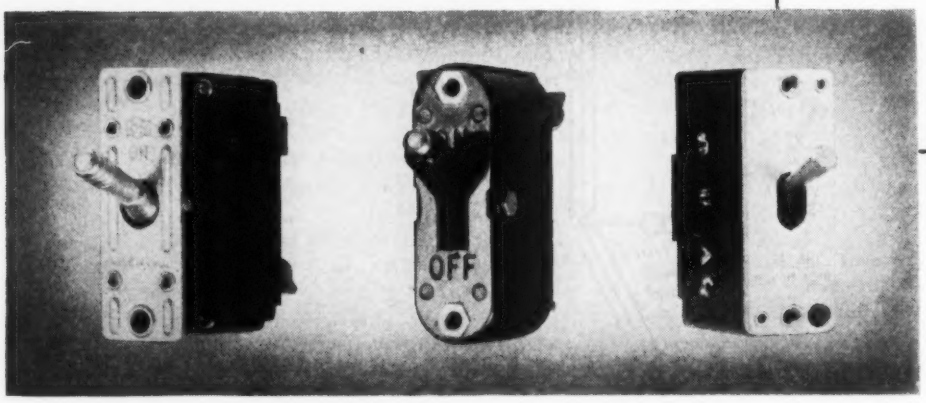


Fig. 5—Three types of switch-operated circuit breakers.

developments were toward increased rating in the same space. As a result in the same space that was once used to control 10 amp. at 15 volts or 150 watts it is now possible to control 50 amp. at 30 volts or 1,500 watts, an increase of 10 times. With a.c. power, 25 amp. at 120 volts or 3,000 watts can be controlled in the same space.

Toggle-actuated switches for aircraft are shown in Fig. 2. Available switch arrangements include SPST On and Off, SPST Momentarily On and Off, SPDT On-Off-On, SPDT Momentarily ON-Off Momentarily On, SPDT On-Off-Momentarily On. Similar double-pole switches are also available.

There are also wide applications for low travel switches for marking limits of actuator travel. Normally these switches control relay and contactor coils only, therefore, their current rating is low. One type is shown in Fig. 3. Current developments are leading to higher ratings.

Circuit breakers are limited to the same space as switches for comparable ratings. These control devices separate the individual circuit from the feeder at a point as near to the latter as possible. If this point is accessible it may also be the switching point, then a toggle-type of circuit breaker is used. If the switching control must be located at a remote point a pushbutton type of breaker is used, and the switching device is located farther down the circuit. In a correct installation, the protective circuit breaker is located at the bus and feeder network. In Fig. 5 are shown various types of switch operated circuit breakers for aircraft.

Application of protective devices to the complete system is indicated in Fig. 4. Sources of power with a channelled feeder network are shown without any protective device since experience has shown that cables which are cut by gunfire will clear themselves by magnetic blowout and burning of flared conductors. This does not mean that an acceptable protective device for each section of the feeder network is not desired. There has not yet been designed a device of desired weight which will provide adequate protection when both maximum and minimum generating capacity are available.

Circuit breakers which protect individual circuits should be connected to junction points in the feeder network so that power can be supplied to the individual circuit from two or more di-

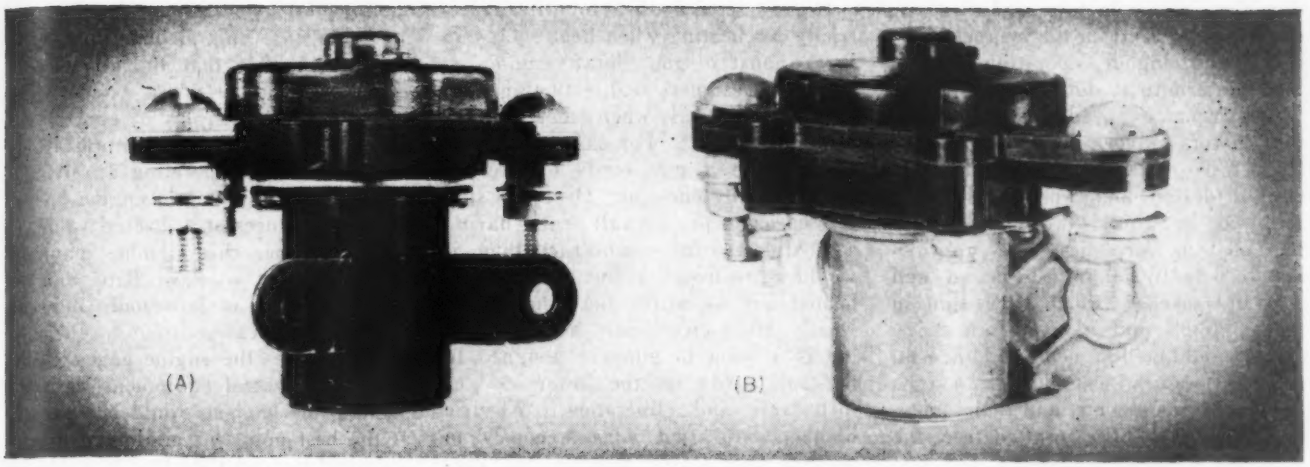
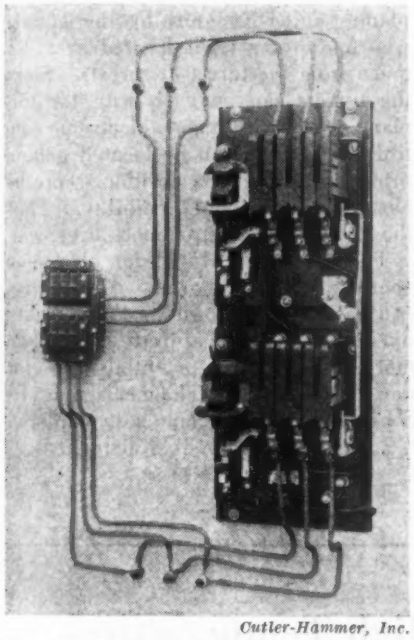


Fig. 6—(A) 30 volt, 200 amp., low pickup voltage relay for intermittent duty, weighs 1¼ lb. (B) 30 volt, 200 amp. relay for continuous duty, weighs 1¼ lb.



Cutler-Hammer, Inc.

Fig. 7—Comparable aircraft and commercial contactors of same rating.

rections. These circuit breakers, as mentioned previously, should be located as close as practicable to the power junction to reduce vulnerability and to protect all the individual circuits. Items such as motors and electronic equipment should have built in protection.

Another item of control is the relay or magnetic contactor. If any differentiation in nomenclature is needed, a relay utilizes one circuit to control several circuits, whereas a magnetic contactor is used to control large amounts of single-circuit power. There are wide applications for both types on aircraft. Two relays are shown in Fig. 6. Three important lessons in relay construction have been taught by experience in the current war.

First, any relay should be balanced so that it has no critical vibration characteristic in the range from 10 to 2,000 cycles per sec. A relay which closes or opens under a shock loading up to 10 *g* or which chatters at some resonant frequency can be more of a hazard than an advantage in aircraft.

Second, relay contacts should be inclosed. An inclosure serves many purposes. It excludes dust and sand which could interfere with closing circuit contacts. In addition, sand could interfere with the movement of pivot points which would seriously alter the calibration of the relay. With proper design, the inclosure will exclude moisture, humidity and salt-laden atmosphere. To be perfect on all these counts, a hermetically sealed inclosure is required.

Third, a good inclosure may permit an increase in rating of the relay, particularly at high altitude. Again, a hermetic seal would be advantageous for this purpose. Possibly, a hermetically sealed relay filled with an inert gas under pressure would perform the same at altitude as at sea level.

Astonishing progress has been made in the design of relays; their sizes and weight cannot be appreciated from an inspection of Fig. 7. If ratings of these relays are compared with those used in industrial practice, the progress made by the aircraft electrical designers will be evident. Some magnetic contactors use little more than one percent of the space and weight formerly used by industrial designs of the same ratings.

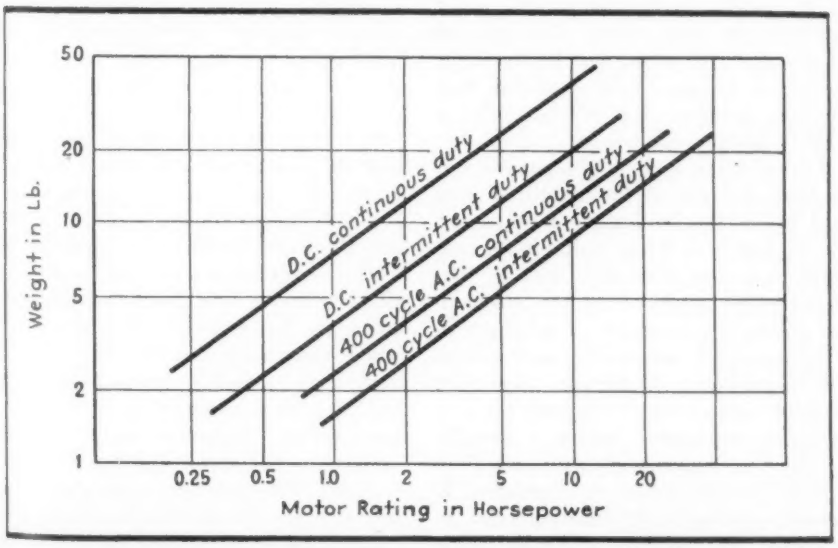


Fig. 8—Possible weight characteristics and rated horsepower for four types of aircraft electrical motors based on optimum speed for minimum weight.

Aircraft Electrical Loads

In a military airplane the loads on the electrical system consist largely of motors and radio equipment. Minor loads are for heating and solenoids. The progress made in electric motor designs, shown by the graph of specific weight in Fig. 8, is comparable to that of generators although the same degree of weight reduction has not yet been achieved. Reduction of motor weight results from the use of higher current

densities in conductors and brushes, higher flux density in the magnetic sections, and higher operating speeds. Some intermittent duty motors run at 24,000 r.p.m. Speeds of continuous duty motors range from 8,000 to 12,000 r.p.m. To obtain such performance, careful design and workmanship are required, but this is worthwhile since the modern airplane costs approximately 6 to 10 dollars per pound, and a pound saved is worth its weight in gold. Motors and other aircraft accessories should be designed and built with these cost values in mind.

Many developments, and their potential advantages, have resulted from the activities of radio engineers, but this information cannot be released until the war is won. With the new devices, aircraft now accomplish missions which were impossible a few years ago. Equipment has been developed which can operate at extremely high radio frequencies, thus avoiding many difficulties encountered in conventional radio reception. The new developments will also make it possible for transport aircraft to maintain safely schedules that are impracticable today.

In military aircraft many solenoids are used for translating electrical energy into axial mechanical movements. A few of the many popular applications for solenoids are the magnetic contactors previously mentioned, bomb-rack solenoids, gunfire solenoids, and latching mechanisms.

It may seem foolish to utilize electricity for heating when heat energy in the exhaust of the aircraft engines is wasted. Designers realize this and use electrical heat only when other methods are not practical. For example, at low temperature a gun tends to clog or freeze at only one spot. Over this spot it is easier to put a small heater having a flexible wiring connection than it would be to install a duct for carrying heated air to warm the whole gun. Neatly fitted electrically heated clothing is a boon to gunners assigned to the ball turret on the lower side of fortresses and liberators. Electric blankets are used advantageously to prevent undesirable fogging and condensation of moisture within cameras.

Electronic Controls

The field of electronic controls offers a tremendous opportunity to the aviation electrical engineer. An example of electronic control is the electric automatic pilot in which two gyros provide the reference axes for control of the airplane. When the airplane deviates from the reference line an electrical signal is developed. The signal is amplified sufficiently by electronic means to operate the servo mechanism at the control surfaces, aileron, elevator or rudder. In turn, a follow-up signal, from the control surface back to the amplifier, is used to damp undesirable oscillations The electric automatic pilot operates so quickly and smoothly that the airplane passenger does not realize that the air may be rough.

Electronic principles of control can be used for many other applications. One problem in operating an airplane efficiently is to maintain engine operating temperatures at a desired value. In most airplanes this is done manually by adjustment of cowl flaps and oil cooler shutters at spasmodic intervals without any great accuracy by the pilot as he watches the engine gages. With electronic control equipment the cooling flap mechanisms could be operated at the best point for minimum drag of the airplane and therefore a maximum range could always be realized.

Another application of electronic devices is the remote control of the airplane's defensive guns by the gunner who operates a sight located at a distance from the turret or turrets. Since the turrets can be flush with the airplane's skin, with remote electronic control, the gunner can be located behind protective armor at a position where he has the best possible visibility. Thus the gunner can control more firepower.

The limit of the field for electronic controls is not known. Any device can easily pay its own way if it makes operation of large aircraft easier and more efficient. All potential uses for new devices and developments must be constantly and systematically explored to make the best possible airplane.

Injection Molding Compounds Withstand High Temperatures

POLYDICHLOROSTYRENE, known as Styramic HT, retains the dielectric loss characteristics of polystyrene but has in addition heat resistance, according to C. L. Jones, Monsanto, Chemical Company. In a paper presented at the fall meeting of the Society of the Plastics Industry it was pointed out that insulating parts molded of this resin may be operated continuously at temperatures as high as 65 deg. F. over the ceiling for polystyrene. The actual A.S.T.M. heat distortion point is 236 deg. F. The heat resistant qualities of Styramic HT are not reflected in a high processing temperature, which varies between 475-550 deg. F. The resin sets rapidly upon entering a chilled mold. Laminar-flow freeze marks, and short pieces can be prevented by heating the mold to 190-220 deg. F. with circulating hot water or steam. Although production of Styramic HT is now on a pilot-plant scale, a production unit is under construction, and shortly after the first of the year the resin will be available in larger volume. It is expected that, postwar, Styramic HT will be useful in high-frequency electronic devices.

Cerex resins include compounds formulated for use at temperatures from just below the boiling point of water, at 212 deg. F. to others suitable for continuous use at over 300 deg. F. The Cerex resins approximate the mechanical strength properties of polystyrene. They are rigid, non-ductile materials of low elongation. Under an increasing applied stress, polystyrene does not give or yield appreciably before it actually breaks, as contrasted with cellulose acetate which shows a considerable amount of plastic deformation prior to fracture. The behavior of Cerex resins is similar to polystyrene in this respect.

This characteristic means greater toughness and becomes more noticeable as one proceeds up the scale to the higher heat resistant Cerex compounds As an example of this point, the A.S.T.M. flexural strength of polystyrene is between 8 to 10,000 lb. per sq. in. and the similar value for Cerex X-214 is 15,000 lb. per sq. in. The more heat resistant Cerex resins have less tendency to craze under stress polystyrene.

The formulation of Cerex resins for heat resistance has a very considerable effect on the dielectric loss properties which determine the efficiency of the material as a high frequency electronic insulator. Increasing the heat resistance increases the dielectric loss by raising both the power factor and the dielectric constant. The dielectric strength is over 400 volts per mil. Arc resistance is good —comparable to polystyrene and other thermoplastics—and volume and surface resistivity are adequate.

Sealants for Metal Castings For Varying Degrees of Porosity

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Monsanto Chemical Company

Materials and impregnation methods for various metals are discussed on the basis of requirements of a satisfactory sealant. The article gives details of a new synthetic resin-styrene copolymer solution that has high efficiency for sealing porosity in magnesium castings.

BOTH organic and inorganic materials have been used to seal porous castings with varying degrees of success. Before discussing the relative merits and disadvantages of these materials it would be well to note that the requirements of a satisfactory sealant are:

1. High sealing efficiency, involving good adhesion to metal, low shrinkage, low volatility and adaptability to porosity of varying degrees of fineness.
2. Ease of handling. The sealant should preferably be furnished as a single solution or if made of two components they should be readily mixable.
3. Stability in impregnating tanks.
4. Inertness when cured. Resistance to heat and various fluids should be very high.

Methods of Impregnation

Several methods for impregnating porous castings with various sealant materials are available. The more widely used methods are listed and briefly discussed below.

Immersion. Where a film of sealant on the surface can be tolerated, the most practical manner of impregnation consists of immersing the casting in the sealing medium, withdrawing the metal and baking dry. The coating thus formed serves to prevent corrosion and stop leaks.

In most applications, especially high magnesium and aluminum, the finished castings are machined to close tolerances which precludes the possibility of films remaining on the surface. Consequently, this method is limited in applicability.

Direct Pressure. For individual hollow castings, the method usually employed is that of "direct pressure." Here all large openings except one are closed. The casting is filled with the sealant, which is placed under pressure until penetration of the pores is obtained. After draining and washing off excess impregnant the castings are heated to cure the sealant. This method provides good sealing efficiency for all types of porosity.

Batch or Immersion Pressure. It is usually uneconomical to treat small castings or large complex castings individually. A more suitable technique involves the batch or immersion-pressure method. When using this method, a quantity of castings are placed in a basket and suspended in a pressure vessel which contains the sealant. Pressure of about 10 to 90 lb. per sq. in. is then applied to the vessel and the impregnant is forced into the pores of the casting. Subsequent washing and baking complete the cycle.

Vacuum-Pressure. The batch-pressure method is frequently modified by evacuating the air in the tank prior to pressure treatment. The use of a vacuum results in a more thorough penetration of fine porosity conditions.

Sealant Materials

A number of different materials or processes have been used or proposed for sealing castings. Among the more prominent of these are Parkerizing, phenolic solutions, sodium silicate, tung oil, styrene-oil compounds and styrene-dehydrated divinyl benzene compounds.

In this country the Parkerizing treatment has been applied to a limited extent to small castings showing slight leakage. It has proved successful for small ferrous castings where tolerances are not held to close limits, since there is a tendency to build up dimensions as much as 0.0005 to 0.001 inch.

Solutions of phenolic resins have been applied in sealing iron, brass and bronze castings. Where the porosity encountered is very fine a liquid solution is applied. For porosity showing more deeply seated pores a solution carrying a fine siliceous powder is used. Following impregnation, the castings are cured by baking at 170 to 270 deg. F. for three hours. Although this method provides a sealant when cured which is tough and unaffected by water, steam, hot oil, chemicals or temperatures up to 400 deg. F. it displays certain inherent disadvantages. A volatile solvent is necessarily employed and the escape of the solvent during curing tends to leave some porosity and exuded materials on the surface.

Sodium silicate is widely used for aluminum and to a lesser extent for magnesium. The castings are impregnated and then fixed by baking in a circulating oven. Sodium silicate has the advantages of low cost and freedom from fire hazard but it cannot be used where the porosity is extremely fine. There is also some question as to the stability of the material under service conditions. Some reports indicate that it is not resistant to boiling water and that there is some possibility of silicate particles being introduced into fluid systems.

Tung oil was widely used before the war as a sealant for porous magnesium castings. Reports on its value vary. It has the advantages of relatively low cost and freedom from fire hazards. In addition to some questions on its sealing efficiency, however, it presents certain difficulties in application. Tung oil must be heated to about 200 deg. F. to attain satisfactory viscosity. The stability of the impregnant in the tank is therefore somewhat low. It also shares the disadvantage of other natural materials, namely, lack of uniformity.

In general, tung oil and certain other polymerizable oils which have been tried are difficult to handle and provide only a surface cure which adversely affects the permanence of the seal under severe operating conditions.

When tung oil was curtailed, styrene-linseed oil and styrene-dehydrated castor oil compounds were developed. The same procedure as developed for tung oil was applicable for these materials without the inconvenience of using high temperature for impregnation. Here, again, divergent results were re-

Table I—Properties of Styrene-Resin Type Casting Sealant *

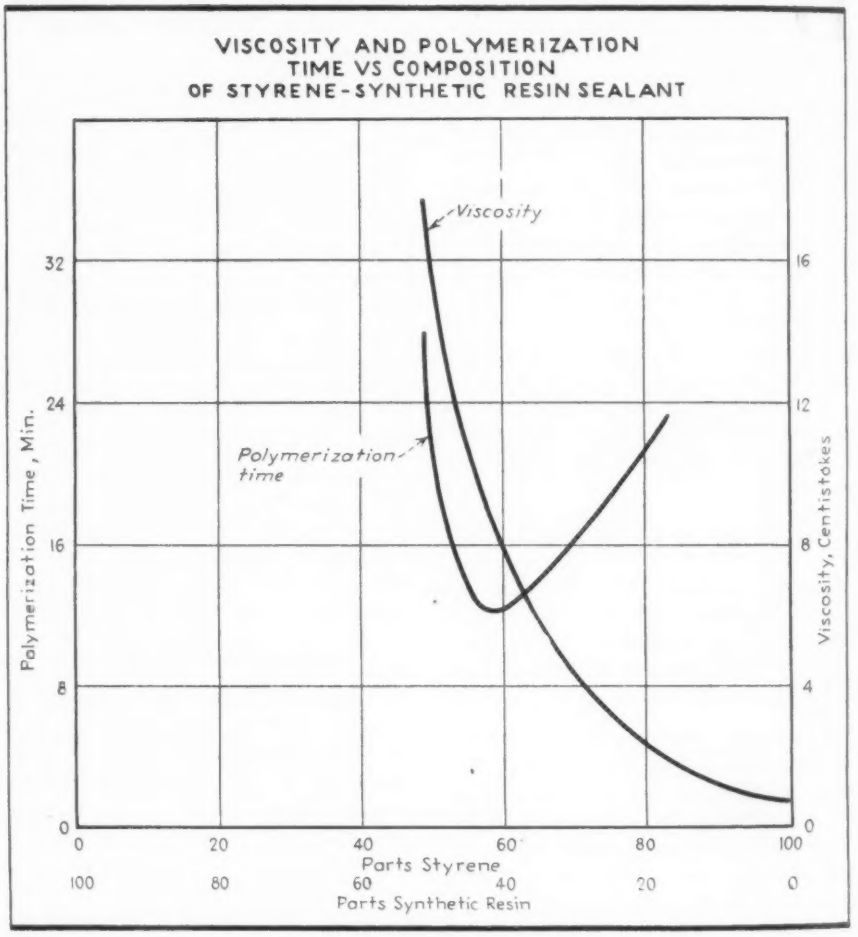
Formulation		Inhibitor	Viscosity at time of preparation, centistokes	Viscosity after 7 weeks at 25 deg. C., centistokes	Stability at 25 deg. C., days	Viscosity after 1 month at 104 deg. F., centistokes	Stability at 104 deg. F., days	Polymerization time at 250 deg. F., minutes	Specific gravity	Viscosity after 10 weeks at 104 deg. F., centistokes
Styrene	XR-146–16 Resin									
80	20	0.25	2.47	2.60	Greater than 100	2.52	80	21	0.938	2.88
70	30	0.25	4.32	4.32	Greater than 100	4.50	47	17.5	0.953	——
60	40	0.25	7.64	8.60	Greater than 100	9.02	65	12	0.969	12.5

*Based on original data by Monsanto Chemical Company, Plastics Division.

ported. Some manufacturers described sealing efficiency as questionable while others reported excellent results. They share several limitations, because each of these formulations tends to be thermoplastic and exhibits questionable resistance to gasoline or similar solvents. In addition, a peroxide catalyst is required for cure, a factor which introduces some hazards, and the components must be mixed by the consumer before they are used.

To overcome the gasoline susceptibility and thermoplasticity of the styrene-dehydrated castor oil compound, a casting sealant was developed which was thermosetting and gasoline resistant. This compound was similar to the styrene-dehydrated castor oil formulation but contained a small percentage of divinyl benzene solution the function of which was to provide the necessary thermosetting elements. Although this formulation achieved its purpose in circumventing the limitations of the original styrene-dehydrated castor oil compound and produced a material with excellent rubbery characteristics, it introduced additional difficulties in that the stability at room or slightly elevated temperatures is short. The ingredients must be mixed and the explosive hazard associated with peroxide catalysts is present.

Each material has merits which justify its consideration, but all have been deficient to varying extents from the viewpoints of sealing efficiency, handling or stability—the three main criteria of a good sealant.

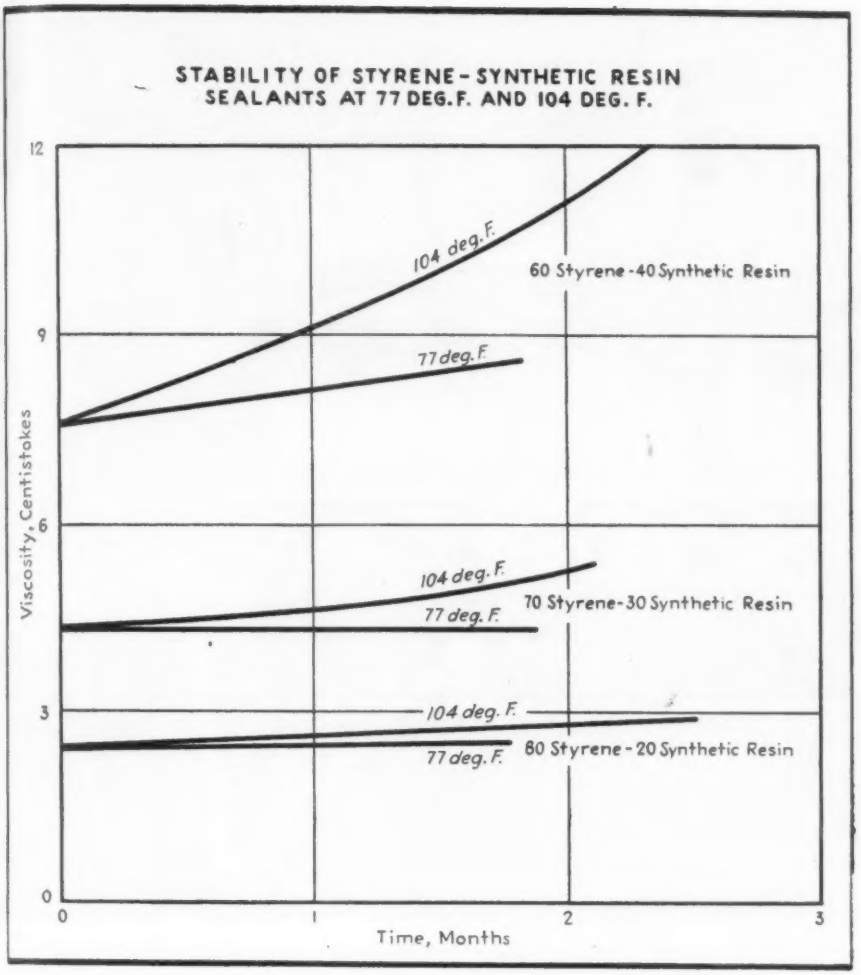


Resin-Styrene Copolymer

One of the latest sealant materials to be developed is a solution of a synthetic resin-styrene copolymer which gives high efficiency in sealing magnesium porosity. A viscosity range of from 2.8 to 7.8 centistokes has been determined to be optimum for sealing efficiency of magnesium. Compared with a number of materials, results indicate that the resin-styrene copolymer material has better sealing efficiency than any other sealant evaluated. The test consisted of machining test blocks out of risers in magnesium castings, measuring their porosity, and classifying them according to the amount of porosity. Blocks in a range of porosities were then selected, sealed with the solution in question and pressure tested.

Results of extensive tests indicate that although this resin has certain limitations it has inherent advantages over previous sealants. The final product combines ease of handling with high sealing efficiency, especially where applied to the difficult-to-seal microshrinkage found in magnesium. Resistance to aromatic 100-octane gasoline, lubricating oil, ethylene glycol, liquid trichloroethylene, and mineral spirits are characteristics of the resin-styrene sealant and the nature of the polymer insures maintenance of the seal under high-frequency vibratory stress. It does not tend to powder.

This material has been termed a



solventless polymerizable resin. The polymer is cured by a copolymerization of styrene and the resin within the pores of the metal. The same equipment used in the processing of tung oil and styrene-oil combinations can be employed for this material.

By varying the relative proportions of styrene and resin, compositions are obtained which seal magnesium, aluminum and iron with good efficiency. No attack on the metal is evidenced. Formulations found most suitable for certain metals are:

Formulation Number	Percent Styrene	Percent Resin XR-146-16	Metal
X-117	75	25	Magnesium
X-118	70	30	Aluminum and Magnesium

Extensive tests, the results of which are reported in Table I, have been conducted on the whole range of resin-styrene sealants.

In the determination of polymerization times, a test similar to that used for tung oil, ASTM D555-41, was used. A sample of 5 to 6 cc. of sealant solution is placed in a test tube 150 x 16 mm. together with a 5-mm. glass stirring rod. The test tube and contents are suspended in a 250-deg. F. constant-temperature oil or glycerine bath. The stirring rod is lifted at 15-sec. intervals. The gel point or polymerization time is considered reached when the test tube can be lifted by the stirring rod.

Viscosity measurements were determined in a #300 Fenske viscometer at 25 .1 C., and the stability tests were conducted at 77 and 104 deg. F. by storing the samples in closed vials and periodically noting the appearance.

Figs. 1 and 2 are graphs of the data obtained. From Fig. 1 it can be seen that the viscosity increases with increasing resin content. Since higher viscosity materials seal larger pores more efficiently than thin solutions, it would appear that a sealant with high base-resin content would be suitable for large porosity. This has been confirmed in practice. Also from Fig. 1, the relationship between polymerization time and composition becomes more apparent. Fig. 2 illustrates the change in viscosity, which is a function of stability, with time.

Production tests show the styrene-resin copolymer to have very high sealing efficiency. From Table II it can be seen that the styrene-resin copolymer seals in the lowest viscosity and is superior to other styrene copolymer sealants with respect to stability, gasoline resistance and reactivity. In addition, a tough resilient polymer results which is thermosetting and handling of the sealant is much simpler. Since the material is supplied as one solution, the mixing and addition of peroxide catalysts are eliminated.

Table II—Comparative Data on Sealants

Material	Viscosity, deg. MacMichael (a)	Polymerization Time, min. (b)	Stability at 25 deg. C., days	Stability at 104 deg. C., days	Gasoline Resistance, percent loss (c)
Styrene-XR-146-16 Resin	18–35	8–30	Greater than 100	47–80	4.8
Styrene-Linseed Oil	50	45	60 or better	——	Dissolves completely after 22 hr.
Styrene-Dehydrated Castor Oil-Divinyl Benzene	110–130	18–20	5–30	2	26

(a) Viscosity determined at 52 r.p.m., full cup, #30 wire, and 28 deg. C.
(b) Polymerization tests conducted at 250 deg. F. for the styrene-resin and styrene-dehydrated castor oil-divinyl benzene sealants and at 275 deg. F. for the styrene-linseed oil materials.
(c) Sample refluxed in 100-octane gasoline then dried at 210 deg. F. for 12 hr.

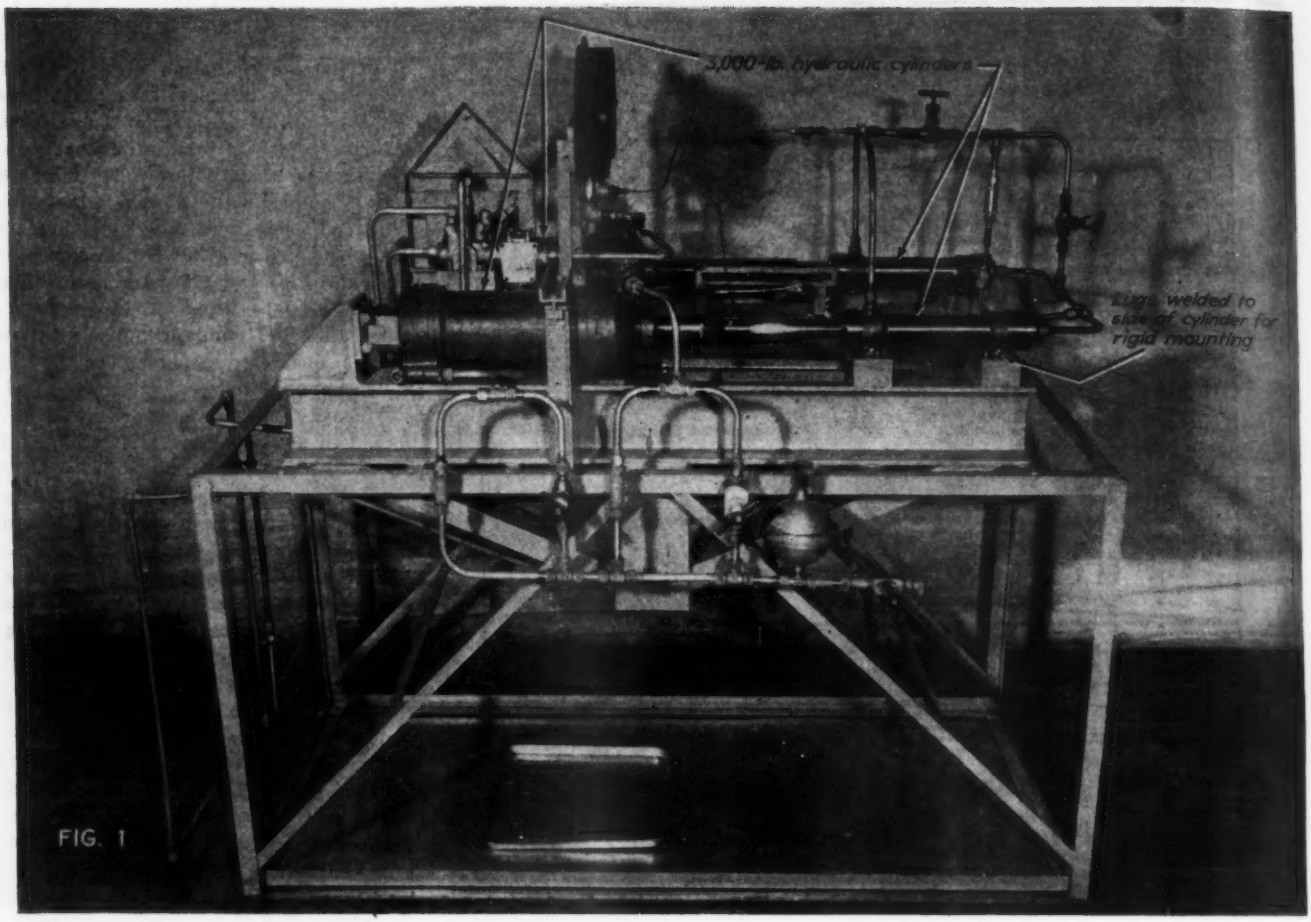


Fig. 1—Equipment used in testing O-ring packings under a differential pressure of 3,000 lb. Cylinders stay in phase as long as packings are in satisfactory condition.

O-Ring Packings Adapted For 3,000-lb. Pressures

RICHARD L. HAYMAN
Hydraulics Group Engineer, Lockheed Aircraft Corporation

Describing a successful method of utilizing synthetic rubber O-rings in reciprocating hydraulic equipment at double the maximum pressure previously considered practical, and the method of testing such operation under adverse conditions.

THE simplicity of design and application of O-ring packings in hydraulic and pneumatic equipment has been so advantageous that efforts are being made to extend their use to systems in which the pressure is greater than the former top limit of 1,500 lb. per sq. in. Packings of this type are of circular cross-section and are made of synthetic rubber to Army-Navy Specification AN-HH-P-114. More detailed information on O-ring packings for pressures up to 1,500 lb. per sq. in. is given in September, 1944, PRODUCT ENGINEERING.

At pressure higher than 1,500 lb. per sq. in., O-rings tend to extrude into the clearance space between piston and cylinder, or between piston rod and surrounding walls. Since higher pressures allow reduction in size and weight of hydraulic equipment, which is particularly important in aircraft, and because of the desirability of using O-ring packings, Lockheed Aircraft Corporation conducted an engineering research and test program to develop means for preventing extrusion of O-rings at 3,000 lb. per sq. in. Various types of metal backing rings were tested with-

out satisfactory results before the problem was solved by using leather backing rings on both sides of the O-rings.

Equipment used in testing packings is shown in Fig. 1. It consists of two hydraulic cylinders 2¼ in. in diameter, one driving a 5½-in. dia. cylinder; the other small cylinder is driven by a second 5½-in. dia. cylinder. The two test cylinders were operated at a differential pressure of 3.000 lb. per sq. in., one conventionally and the other with pressure applied in a direction opposite to the direction of piston motion. Test cylinders were mounted in such a way as to give an effective side load caused by misalignment and deflection. Piston heads were installed with a diametral clearance of 0.007 in. and the operating diametral deflections at 3,000 lb. per sq. in. were 0.004 in. at the center of the barrel and 0.008 in. at each end. This resulted in a maximum diametral clearance of 0.015 inch.

While this clearance may be considered high, it was felt that such conditions might be encountered in service, particularly after a cylinder has been rehoned. The side load was considered essential because it is virtually impossible to eliminate all side loads in service.

For comparative purposes tests were run at 1.500 lb. per sq. in. differential on O-rings of the best material for this pressure in both rectangular and V-grooves. Failures occurred at 15,964 and 3,569 cycles respectively. Failure was considered to exist when the test cylinders became out of phase because with this arrangement of equipment proper cycling could not be obtained. Although the V-groove was installed in the unconventional cylinder, later checks showed little difference in which cylinder it was installed. The V-groove was always less successful than the rectangular groove.

Similar tests at 3,000 lb. per sq. in. in rectangular and V-grooves resulted, as expected, in early failures at 1,260 and 1,200 respectively. When metallic rings of several different shapes were installed on both sides of the O-rings,

Fig. 2—Metal back-up rings with beveled slit for expansion caused failure of O-rings by cutting or pinching in the opening and closing of the slit in each piston stroke.

Fig. 3 — O-rings protected by chrome leather back-up rings operated satisfactorily at 3,000 lb. They operated longer in the test machine than unprotected rings at 1,500 lb. pressure.

Fig. 4—Two leather back-up rings protect O-rings under pressure in both directions of piston stroke.

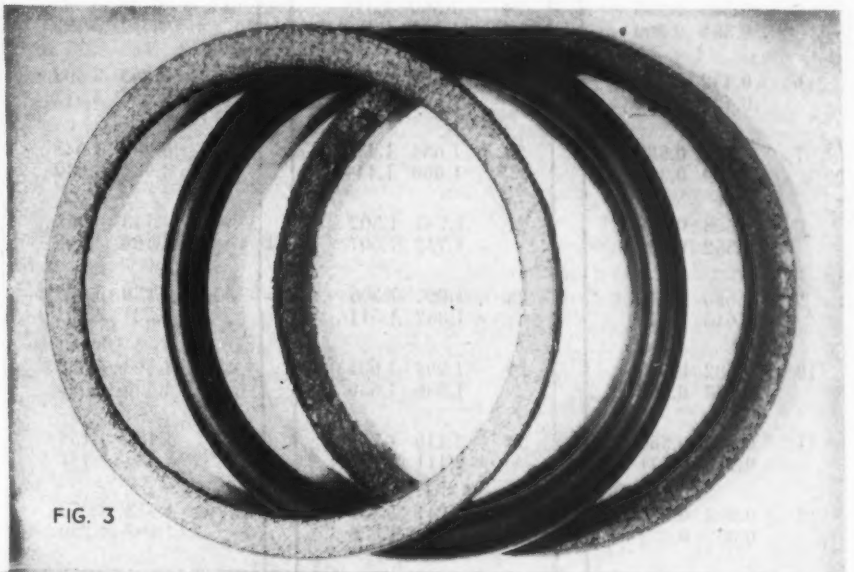


FIG. 3

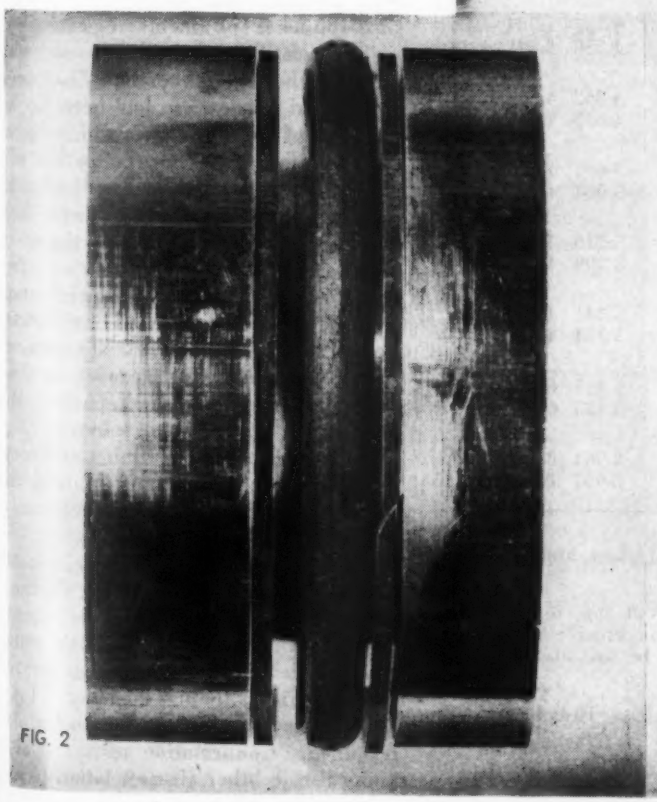


FIG. 2

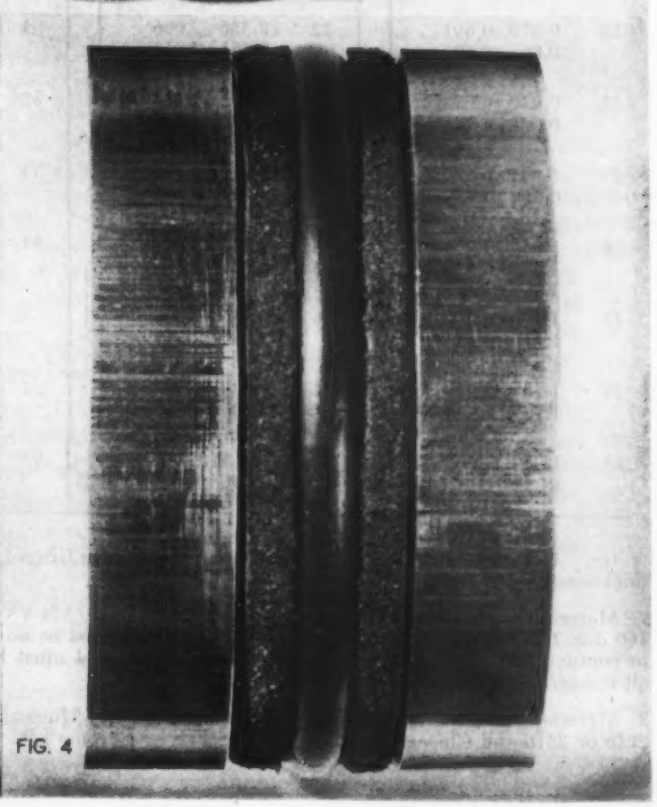


FIG. 4

Table I—Leather Back-Up Ring Sizes for O-Rings

AN 8227 O-ring Dash No.	Ring O.D.	Ring I.D.	T±.010 Ring Thickness
1	0.244 0.239	0.130 0.135	0.062
2	0.275 0.270	0.161 0.166	
3	0.306 0.302	0.192 0.198	
4	0.338 0.333	0.224 0.229	
5	0.369 0.364	0.255 0.260	
6	0.432 0.426	0.318 0.322	
7	0.494 0.489	0.380 0.385	
8	0.558 0.552	0.378 0.383	
9	0.620 0.615	0.441 0.446	
10	0.682 0.678	0.503 0.508	
11	0.745 0.740	0.566 0.571	
12	0.808 0.802	0.628 0.633	
13	0.870 0.865	0.691 0.696	
14	0.932 0.928	0.753 0.758	
15	0.997 0.992	0.752 0.757	
16	1.060 1.054	0.814 0.820	
17	1.122 1.116	0.877 0.882	
18	1.184 1.180	0.940 0.944	
19	1.247 1.242	1.002 1.007	0.062
20	1.310 1.304	1.064 1.070	0.062
21	1.372 1.367	1.127 1.132	
22	1.434 1.430	1.190 1.194	
23	1.497 1.492	1.252 1.257	
24	1.560 1.554	1.314 1.320	
25	1.622 1.617	1.377 1.382	
26	1.684 1.680	1.440 1.444	
27	1.747 1.742	1.502 1.507	0.062
28	1.867 1.862	1.506 1.511	0.125
29	1.991 1.986	1.631 1.636	
30	2.116 2.111	1.756 1.761	
31	2.241 2.236	1.881 1.886	
32	2.336 2.361	2.006 2.011	
33	2.491 2.486	2.131 2.136	
34	2.616 2.611	2.256 2.261	
35	2.741 2.736	2.381 2.386	
36	2.866 2.861	2.506 2.511	
37	2.988 2.981	2.633 2.640	
38	3.113 3.106	2.758 2.765	0.125
39	3.238 3.231	2.883 2.890	0.125
40	3.363 3.356	3.008 3.015	
41	3.488 3.481	3.133 3.140	
42	3.613 3.606	3.258 3.265	
43	3.738 3.731	3.383 3.390	
44	3.863 3.856	3.508 3.515	
45	3.988 3.981	3.633 3.640	
46	4.113 4.106	3.759 3.766	
47	4.238 4.231	3.884 3.891	
48	4.363 4.356	4.000 4.016	
49	4.487 4.480	4.134 4.141	
50	4.612 4.605	4.259 4.266	
51	4.737 4.730	4.384 4.391	
52	4.862 4.855	4.509 4.516	
53	5.091 5.084	4.656 4.663	
54	5.216 5.209	4.781 4.788	
55	5.341 5.334	4.906 4.913	
64	6.465 6.458	6.031 6.038	
73	8.964 8.957	8.531 8.538	0.125

Notes. 1. Rings must be clean cut and square, free from fringed edges, and of uniform thickness.

2. Material must withstand immersion in hydraulic oil (AN-VV-0–366) for 7 days at 160 deg. F. without any deterimental effects. There must be no corrosive action when in contact with ferrous or non-ferrous metals. Material must be soft and pliable at all temperatures from −65 to 160 deg. F.

3. Material—Rock Island Arsenal Specification 95-A. Alternates: Houghton's Vim 2216 or 2316 and Chicago Rawhide H. E. Servis or Chrome Elk.

failures usually occurred even earlier than without such anti-extrusion devices. Metal rings that were made expansible by means of a beveled slit, as shown in Fig. 2, failed because of cutting produced by the edge of the slit or by pinching in the slit as it opened and closed during operation. O-rings failed at 753 cycles in one test.

Anti-extrusion rings of a softer material were then tried. Leather proved to be the most successful. All O-rings that have been so protected have operated for a minimum of 20,000 cycles. Figs. 3 and 4 show that wear on the O-rings is practically negligible. Because of the difficulty of obtaining quantitative friction data on the test equipment used, no definite information was obtained on packing efficiency. Comparative tests, however, show no increase in friction beyond that of the conventional rectangular groove.

Leather anti-extrusion rings are believed to have three distinct advantages aside from the obvious improvement in performance: They make it unnecessary to polish the side walls of the packing groove in order to reduce O-ring wear; they seem to retain some oil, which aids in lubrication; they are simple to manufacture and cheaper than any form of metallic device now known.

Two disadvantages have been noted: The rings must be continuous, that is, without a break; attempts to install them by stretching them over piston heads have not been too successful, necessitating two-piece piston heads for best results. The latter disadvantage also applies if split metal rings are used.

The possibility of a pressure trap between the two leather rings has been discounted since there has been no indication of this condition and it is believed doubtful whether the leather will seal sufficiently to cause such trouble.

Dimensions of leather rings now standard with Lockheed are shown in Table I. Corresponding O-ring sizes are given in Army-Navy Specification AN6227 (see PRODUCT ENGINEERING, September, 1944, page 582, for nominal sizes). Packing ring grooves used in tests are nominally rectangular but have sides with 10-deg. slopes. The sloping sides assist machining and seem to have some advantages in assisting the leather rings to close the clearance space.

The test program is being continued to develop further refinements. Various types of leather and critical tolerances are being investigated, and the suitability of leather backing rings for rotating seals is being checked. Frictional data for the latter is being determined. Confirmation tests are also being run in other aircraft laboratories.

INDUSTRY AND SOCIETIES

ABSTRACTS of TECHNICAL PAPERS

STANDARDS • READER LETTERS • MEETINGS

Forming of Magnesium

From "A Survey of Wrought Magnesium Alloy Fabrication" by J. V. Winkler, Dow Chemical Company. Presented Oct. 16 at the annual convention of the American Society for Metals.

Summarizing the latest practice in shaping magnesium alloy sheet and extrusions, the author pointed out that refinements in fabrication methods are making it possible to produce parts of greater intricacy, and of high quality and low cost. While the necessity for temperatures ranging from 450 to 700 deg. F. is a disadvantage in shaping magnesium sheet, four advantages given by elevated temperature were cited: (1) The metal can be worked more severely at these temperatures than most other metals at room temperature. (2) Parts can be drawn in one operation. (3) Springback is reduced and at the higher temperatures is negligible. (4) Diameter tolerances of drawn parts can be closely controlled by temperature adjustment when dies of different coefficient of expansion are used.

Recent developments in press work indicate that production rates can be speeded. Parts that tend to pucker on the punch, such as those having irregular rounding contours, have been formed on a toggle press having an average punch speed of 60 ft. per min. with less trouble than on hydraulic presses at 3 ft. per minute.

Recently parts with extremely deep draws have necessitated double draws although the technique for hot drawing has been developed with the object of making a part in a single operation. The paper includes several charts showing drawability factors and bend radii for temperatures up to 600 deg. F., and other data. As an example of a double-drawn part, 24-in. blanks of both 0.25-in. FS-la and Ma magnesium were drawn to a cup of 8-in. dia. and 16-in. depth, then redrawn to a 5.5-in. dia. cup 23 in. deep. Single draw was used to make nose spinners 22-in. dia. and 14.5-in. deep in 0.064-in. FS-la or Ma sheet, and for a round nose cylindrical housing 8-in. dia. and 16-in. deep in 0.072-in. Ma sheet.

Shallow parts can be formed by the Guerin process using special heat resisting rubbers. While labor cost is higher than die-formed parts, savings on die cost and the speed with which dies can be produced or revised was said to overcome this advantage, especially in small quantity production. Size of parts should be such as to assure application of at least 1,000 lb. per sq. in. on the rubber pad.

Hand-forming of magnesium is much more difficult than on aluminum because of elevated temperatures. Extrusions can be bent by hand methods using a torch if heat is necessary and checking with a hand pyrometer. Production bending of extrusions can be done on standard angle rolls, in mating dies, in stretch-forming machines or other specialized bending equipment.

Little stretch-forming has been done but indications are that it is practical. Work at room temperature has been limited to annealed sheet, the operation being essentially the same as working aluminum. Domes of 24-in. radius in 0.04-in. Ma sheet have been stretch-formed hot, heat being applied by conduction from the punch.

Drop hammer forming is generally not recommended for magnesium alloys unless the part is relatively simple and can be made in one operation. The main difficulty is in keeping the sheet heated because only a small portion is in contact with the lower die surface.

Limited work on shrinking machines indicates that annealed materials can be shrunk satisfactorily at room temperature. One edge of a 0.04-in. sheet of Ma alloy was shrunk until bent about the neutral axis of a 1-in. width to a radius of 6 inches.

Spinning is being done and it appears that any shape spun in pure aluminum sheet can be formed in either annealed Ma or FS-la sheet by hot-spinning.

Impact extrusion has not been applied enough to establish related limits on wall thickness, diameter, and height. Shells ranging from 1.25-in. dia. and 6.5 in. long with a thickness of 3/32 in. to 5.5-in. dia. and 22 in. long with 0.25-in. thickness have been made from extruded M, FS-1, and pure magnesium stock.

This selection of abstracts of technical papers presented at recent meetings of technical societies opens a new reader service. These abstracts give news coverage on and useful information from papers in the field of PRODUCT ENGINEERING, *and indicate where more complete information on the different subjects can be obtained.*

Magnesium Joining Methods

Developments in welding methods were also summarized by Mr. Winkler. Several welding methods are being used and the choice among them depends upon several factors. Spot welds have been used on primary aircraft structures and are expected to come into general use. Since copper pickup must be avoided to prevent corrosion, electrode tips must be cleaned frequently: After 10 to 20 spots on M alloy, 30 to 50 spots on FS-1, and from 100 to 150 spots on J-1 alloy.

The advisability of fabricating a structure by fusion welding in preference to riveting, spot welding and other methods, is usually dictated by the shape of the structure and the purpose for which it is intended. The decision between gas welding and arc welding is more difficult. Gas welding is usually preferred to arc welding for sheet less than 0.1 in. thick when stresses are not high. Fit up is not critical for gas welding, and the possibility of welding gaps as large as six times material thickness is advantageous, particularly on com-

plicated parts. The closer fit up for arc welding would require fairly elaborate jigging. Gas welding is also easier to use and frequently lower in cost than arc welding, Winkler said. It is not necessary to stress-relieve gas welded M alloy assemblies. The ideal gas is a mixture of hydrogen and methane.

Flux difficulties limit gas welding to butt-type joints or corner joints that do not entrap flux, because of corrosion produced. All joints should be limited to stock no more than 0.25 in. thick, which can be welded in a single pass for this reason. Gas welding is also preferably limited to joining like alloys although welds may be satisfactory if the materials have the same alloying elements and their melting points are nearly equal.

The use of arc welding in preference to gas welding is often dictated by the type of joint required, such as lap and fillet joints. Arc welding is also preferred when warpage must be minimized. It is employed where maximum strength joints are required in M and J-1 alloy structures. All wrought materials except FS-1 have good arc welding quality.

Resistance flash welding has not been used extensively in spite of the fact that adequate experience has been obtained to show the process is feasible. Butt welding, where the current is applied after the pieces to be joined are butted together, is not as successful as flash welding. Higher current is required, it is slower, and parts must be fitted more carefully.

When cast fittings or fittings machined from extruded stock are to be welded to sheet they should have flanges of about the same thickness as the sheet.

Bonding cements have not been used on a production scale but an extensive test program has been completed and will soon be put to use. Strengths that compare favorably with those obtained in aluminum alloy joints were obtained. The best method of surface preparation was still being studied when Mr. Winkler was preparing his paper.

Aluminum Forgings

From "Aluminum Alloy Forging Materials and Design" by L. W. Davis, Aluminum Company of America. Presented Oct. 17, annual convention, American Society for Metals.

The outstanding record of aluminum alloy forgings in airplane engines assures their continued use and a trend toward large and complicated forgings in aircraft, the author believes. Wider application of the forged cylinder head is expected because it is more economical and efficient, especially in large scale production.

Forging machines specially developed for aluminum can produce aluminum forgings rapidly with small dimensional variations, smooth surfaces, and resultant savings in finishing time. While large complicated forgings mean higher material cost, lower over-all construction cost results because costly assembly is avoided.

Rapid development of forging technique and of forging presses specially designed for aluminum alloys are important factors in the application of aluminum forgings. Aluminum should be worked with a comparatively rapid pressing speed and long power strokes. The load should be concentrated on a smaller and stiffer platen than had been customary in steel forging presses. For these reasons a new type of hydraulic forging machine was designed.

Larger forging hammers were essential to meet a demand for larger and more complicated forgings. A hammer of 35,000 lb. capacity, nearly twice that of the largest used for steel forging, was designed and several are now operating, as well as many of 25,000 lb. capacity. These hammers made it possible to produce the propeller blades for big bombers, crankcases for the largest radial aircraft engines, and numerous large airframe fittings.

Larger and stiffer upsetters and mechanical forging presses also were built. Some plants are using presses of 4,000 tons capacity for work on cylinder heads and other heavy forgings.

Considerable attention was given by Mr. Davis to forging design. The number of forging operations were said to depend entirely on design. One important difference between steel and aluminum forging is that small folds in aluminum will not weld together and disappear because of the oxide coating film. Also no scaling of surfaces occurs so that small surface defects cannot be eliminated into the scale. One of the objects of designing generous radii and fillets is to prevent formation of folds by assisting the flow of aluminum in its plastic state. The die is also likely to be damaged and to have a short life.

Shrinkage variation in large and intricate forgings is a cause of trouble but can be overcome by design that is suited to machining requirements. Pockets and recesses should be no deeper than two-thirds their diameter. Holes in hubs and bosses can be pressed from each side, leaving a web not less than ⅛ in. thick. The web is punched out to the tangent points of the fillet radii. Holes in webs and flanges are formed similarly.

Atmospheric Corrosion-Resistant Steel

From "Chromium Steels of Low-Carbon Content" by Russell Franks, Union Carbide and Carbon Research Corporation. Presented Oct. 20, annual convention, American Society for Metals.

Parts exposed to weathering, such as roofing, gutters, drain pipes, fencing, and others will have sufficient corrosion resistance if made of 0.10-percent carbon, 3-percent chromium steel, the author reported. Results of tests showed this steel to be at least five times as resistant to corrosion in industrial atmospheres as ordinary low-carbon steel. Oxidation resistance is good up to 1,200 deg. F., 200 deg. higher than for ordinary carbon steel.

This steel was said to have good fabricating properties and small ingots can be hot-rolled almost like ordinary carbon steels. Its high ductility permits bending or forming either hot or cold into any article produced from ordinary carbon steel. Welds are tough at room temperature and at —40 deg. F.

Spreading of Liquid Metal

From "Capillarity of Metallic Surfaces" by E. R. Parker and R. Smoluchowski, both of General Electric Company. Presented Oct. 17, annual convention, American Society for Metals.

The importance of the spreading of liquids over the surface of solids in brazing and coating was emphasized in the results of investigations indicating that the mechanical condition of the surface is a controlling factor. The authors found that liquid metal spreads best on finely ground or on polished and etched surfaces, both of which have fine capillary structure. It does not spread on polished surfaces under the same conditions.

The presence of capillary grooves, machined or etched, and of grain boundaries on metallic surfaces greatly facilitates the spreading of liquid metal. Cleanliness of a metallic surface is not enough to insure spreading. Results are based on experiments with liquid silver at 2,190 deg. F. spreading on variously treated iron (6 percent Mo) surfaces.

Prevention of Stress Corrosion Cracking

From "Magnesium Sheet" by P. T. Stroup, G. F. Sager, and J. B. West, all of Aluminum Company of America. Presented Oct. 17, annual convention, American Society for Metals.

Discussing the relation of mechanical properties of magnesium sheet to their alloy content and cold working, the authors paid particular attention to stress corrosion cracking, which has caused considerable concern because of the desirability of using high-strength magnesium alloys in aircraft.

The most promising solution to the problem has been found to be the application of pure magnesium cladding on magnesium alloy sheet. Commercial production of "Magclad" sheet is being developed. The cladding is applied by making the specimens cathodic in a test solution. Coating thickness on a sample 0.04-in. sheet was about 0.0025 in. on each side.

Stress corrosion cracking was believed more likely to be the result of residual forming or assembly stresses than of design stresses or stresses that result from external loading, because the residual stresses are often considerably higher than the others. Stress corrosion cracking has been confined chiefly to welded assemblies of the higher strength alloys only, and has not been encountered in AM3S, the 1.5-percent manganese alloy.

Both atmospheric and accelerated tests have been employed in investigations aimed to prevent such failures. The latter method now reveals susceptibility to stress corrosion without causing too much general attack, and results have correlated well with those obtained in atmospheric exposure.

Susceptibility to stress corrosion cracking was found to increase with aluminum content of the sheet. Annealed sheet appears less susceptible than sheet in the hard rolled temper and few annealed samples have failed in tests. However, stresses employed were usually based on yield strength, which is considerably lower in annealed material.

Low temperature thermal treatments tend to minimize susceptibility to stress corrosion cracking but do not eliminate the possibility of such failure, particularly if stresses are near yield strength or higher. The most reliable procedure is stress-relieving treatments after forming, welding, or assembly operations. A treatment of 1 to 2 hr. at 300 deg. F. was found to be effective although tensile and yield strengths of hard-rolled sheet are lowered somewhat.

Multiple Torch Pressure Welding

From "Oxy-Acelylene Pressure Welding" by A. R. Lytle, Union Carbide and Carbon Research Laboratories. Presented Oct. 18, annual meeting, American Welding Society.

A new method of welding, using multiple torches and differing from other welding methods in that the weld is made at subfusion temperatures under pressure, instead of in the liquid phase, was described by the author. Several successful applications were reported: Joining railroad rails, overland pipelines from 2 to 24 in. in diameter, oil well tool joints, small liquefied gas tanks, and numerous other production line welding operations, such as aircraft landing gear.

One of the advantages of the method was said to be its adaptability to high-carbon and alloy steels, which are welded with difficulty by fusion welding methods because of the likelihood of impairing the quality of the base metal by overheating, burning, grain growth or other high-temperature reactions. Also fusion welds, except for spot welds, always include added weld metal, thus making a heterogeneous structure. Other advantages are the smoothness and uniformity of the completed weld and short welding time.

Parts to be welded are butted together under pressures of 2,500 to 4,000 lb. per sq. in. usually, heated by the multiple small flames to 2,200 to 2,280 deg. F., and upset to a controlled degree, preferably by means of hydraulic equipment. Welding equipment is designed to suit the parts being welded. Usually either the blowpipes or the work is oscillated. This speeds the welding operations, makes heating more uniform, reduces heat loss, and makes it possible to use smaller blowpipes.

Joints to be butt welded have opposing faces preferably of the same size and shape. If members are of different thicknesses the heavier member is tapered. Considerable data on the physical property characteristics of pressure welds indicate that welds pass specified requirements in present applications. Properties nearly equivalent to the original base metal were obtained. Welds in low-carbon steels and probably in some of the low-alloy steels have good physical properties in the as-welded condition. Some of the higher carbon steels and medium-alloy steels require normalizing to restore a better balance between tensile strength and ductility. This is usually done with the same set of blowpipes with which the welding was accomplished.

The economy of the process results largely from economical use of the expendable items, time and gas. As the entire length of a joint is welded simultaneously the gas consumption is low although the rate of flow during welding is high. This fact also contributes to eliminating residual stresses caused by non-uniform cooling around the circumference when done with a single torch.

Subzero Treating

From "A Study of Subzero Treatments Applied to Molybdenum-Tungsten High Speed Steel" by Ralph G. Kennedy, Jr., Cleveland Twist Drill Company. Presented Oct. 18, annual convention, American Society for Metals.

Detailed study of subzero treatments by the author indicated that nothing outstanding has yet been observed. The best results, a 10 percent improvement in tool performance, were obtained by subzero cooling to −120 deg. F. after single tempering at 1,040 deg. F. for 1 hr. It was thought possible that shorter tempering times and temperatures lower than 1,040 deg. F. might give better results.

Many more controlled tests were believed necessary to determine whether the observed 10-percent improvement in tool performance is a significant increase. It is still possible that certain combinations of subzero cooling and tempering that will have advantages over normally hardened, fully tempered tool steel will be found.

Induction Hardening

From "Induction Hardening of Plain Carbon Steels" by D. L. Martin and Florence E. Wiley, both of General Electric Company. Presented Oct. 16, annual convention, American Society for Metals.

The properties of induction hardened steel are frequently different than when hardening is done by conventional methods, the authors pointed out. This is because it is possible to heat the surface of the metal so rapidly that the core temperature does not reach that of the surface. This makes possible case hardening of a plain carbon steel part in a few seconds with little if any distortion and without the formation of an

oxide scale or a decarburized zone. However, the results obtained in hardening more than 50 specimens indicate that basic metallurgical principles are the same as in conventional methods.

The maximum temperature was found to be the important variable in induction hardening. To obtain satisfactory properties, it is necessary to heat to a temperature at which carbon diffusion is sufficiently rapid. For a 0.45 percent carbon steel, this is about 1,560 deg. F. Temperatures higher than 1,830 deg. F. should be avoided because the increased depth of hardening and homogenization, which generally result, decrease hardness and fatigue properties.

The higher carbon steels are most desirable for induction hardening applications because the heating temperature can be lower, hardness is greater, and they do not require any special prior crystalline structure. Tempering of induction hardened parts was not recommended when maximum wear resistance or fatigue properties are desired.

Test results were based on studies of five plain carbon steels containing 0.2 to 1.1 percent carbon heated by a General Electric electronic heater operated at a frequency of 530,000 cycles. Maximum power input to the specimens was 10 kilowatts up to the critical temperature. Heating rate was 500 to 540 deg. F. per second at this input. Test specimens were 7/8 in. dia. and 1 in. long.

Quality of Soldered Joints

From "Fracture Studies of Soldered Joints" by F. Berman and R. H. Harrington, both of General Electric Company. Presented Oct. 20, annual convention, American Society for Metals.

Studies of soldered copper joint quality by fracture tests indicated that the quality of joints soldered with eutectic silver-copper alloy (71.5 percent silver, 28.5 percent copper) can be greatly improved by keeping soldering temperatures as low as possible, 1,470 to 1,515 deg. F. This reduces shrinkage, surface tension effects, diffusion of base metal into the solder film, and the amount of hydrogen dissolved in the initially molten solder. Joints soldered at this temperature had only a small degree of alloying, if any, by diffusion of copper from the plate into the solder film. There was slight alloying by diffusion of silver from the solder into the copper plate. The addition of 2 percent tin did not appear to improve the eutectic alloy for soldering copper bars, as had been thought previously.

New Standards and Revisions

STANDARDIZATION PROGRAM OF SIGNAL CORPS DESCRIBED

Component parts and materials used in Army Signal Corps equipment are being standardized under the responsibility of the Signal Corps Standards Agency, a unit of the Army Service Forces, established two years ago and located in Red Bank, N. J. Standard specifications covering the more important parts and materials used by the Signal Corps have been issued and a considerable percentage of production has received qualification approval.

The Signal Corps now requires the use of only approved component parts and materials whenever possible in the equipment supplied to it. Signal Corps Tentative Specification 71-4902, which gives the requirements of standard parts and materials for use in Signal Corps equipment, is the medium by which this is effected.

A direct result of this agency's work has been the establishment of Joint Army-Navy Specifications for communication equipment. These standards have been worked out with the Navy Bureau of Ships. These two agencies have had the cooperation of other bureaus of the Navy, services of the Army, Army Air Forces, War Production Board, British armed forces, Canadian Department of Munitions and Supply and numerous companies and associations of American industry.

The program was undertaken to simplify the number of types and sizes required and to provide uniform type designation so that production and deliveries of needed parts and equipment could be increased, inventories could be reduced and replacements in the field could be facilitated; to insure complete interchangeability of the same component parts regardless of manufacturer, purchaser or the service concerned; to increase the effective supply of a given component or material by grading and rating most of the total production, with possible improvement of the lower grades; to effect, where possible, a reduction in the requirements for critical materials; to assist designers by stating the characteristics of the component or material so that minimum satisfactory grades will be used; to reduce both qualification and application testing and the reports, correspondence, conferences, travel, laboratory equipment and personnel incidental thereto; to assure an adequate supply of satisfactory component parts and materials by using those available in production quantities and to assure that quality will be maintained.

A booklet explaining the standardization program in detail, as well as Tentative Specification 71-4902 is available on request to the Signal Corps Standards Agency, Red Bank, N. J.

INTERNATIONAL STANDARDS PROMOTED FOR THREADS

Efforts of American, Canadian and British engineers to arrive at satisfactory standards for screw threads and cylindrical fits that would unify practices in the three countries with respect to threaded parts, were reported on at a recent meeting of leading industrialists in New York sponsored by the American Society of Mechanical Engineers, American Standards Association and Society of Automotive Engineers.

The meeting was in the nature of a report of Anglo-American-Canadian conferences held late in 1943 and in the fall of 1944 in this country and England on standardization of screw threads and cylindrical fits. They were inaugurated by the Combined Production and Resources Board. These efforts at international standardization are expected to facilitate production, maintenance and repair of war equipment and, to some extent, interchangeability of component parts that are identical except for threads, as well as to have a favorable effect on postwar trade. In this connection, William L. Batt, vice-chairman for international supply of WPB, disclosed that differing specifications for screw threads and related items between the three countries have already increased the cost of the war at least $100,000,000 in addition to delaying production and repair.

The results of these conferences have been published in a report issued by CPRD and available in this country through any of the previously mentioned societies or from the Superintendent of Documents, Government Printing Office, Washington, D. C. It is being circulated in Britain by the Ministry of Production. Subjects covered in the conferences and the report, and which were discussed at the recent meeting, are truncated Whitworth threads, cylindrical fits, high-duty studs in light alloys, pipe threads, screw threads for compressed-gas cylinder outlets, Acme threads, buttress threads, instrument threads, unification of screw threads and design and drafting practice.

Discussions and Comments from Readers

ROUGHNESS SAMPLES CAN BE PURCHASED

Numerous inquiries have been received from readers as to the source of supply of the Surfcheck roughness standards described in the articles by James A. Broadston, "Distinctive Symbol Adopted to Designate Surface Finish," p. 704, Oct., 1944, and "Surface Roughness Standards for Tactual Comparisons," p. 756, Nov., 1944, PRODUCT ENGINEERING. For the benefit of those interested these samples are available from the Surface Checking Gage Co., 1937 Taft Ave., Hollywood 28, Calif.

ALTERNATE METHOD FOR DETERMINING COSTS EXPLAINED BY READER

To the Editor:

The informative article, "Relative Costs of Parts Made by Five Different Methods," August, 1944, PRODUCT ENGINEERING, is provided with diagrams of costs per piece which I have long considered unsatisfactory for cost comparisons. Therefore, I would like to show a comparison of the different methods, using the data in the original article.

My method is to plot the total costs against the number of pieces and in cases like those described, approximate straight lines are obtained. The straight line is, however, no essential presumption, but any curve obtained may be approximated in portions by straight lines—for instance, tangents. Owing to their nature the intersection points of these lines can be easier and more accurately found than when using the cost-per-piece curves. In the case of the landing gear attachment I obtain for the critical point about 960 pieces, whereas the drawing in the article indicates about 500 pieces.

Further, the costs for any arbitrary unit of pieces can be easily determined by a graphical method, as shown. In order to obtain a suitably spaced diagram, we select as the unit 100 pieces, but carry out the operation for 400 pieces and use a cost scale one-fourth of the original for the total costs. We mark the perpendicular line through $n = 400$ as pivot line, connect any arbitrary point (1), the piece costs of which we want to find, with the zero point (0) and project the intersection (2) with the pivot line to the perpendicular line through (1), thus finding (3), which is a point on our curve for the costs for 100 pieces.

Of course, the problem is also open to a more mathematical treatment. The total costs can be expressed by the formula

$$C = An + b$$

Thus, for production from bar stock we obtain

$$C_1 = A_1 n + b_1$$

and for forging

$$C_2 = A_2 n + b_2$$

We see that the costs are equal, i.e. $C_1 = C_2$, when

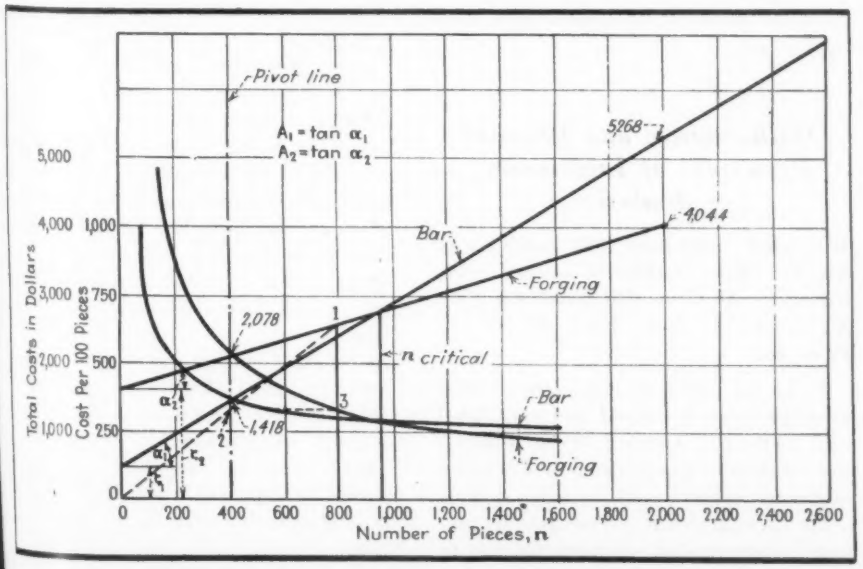
$$n_{crit} = \frac{b_2 - b_1}{A_1 - A_2}$$

The values A_1, b_1 and A_2, b_2 can be found from the given data by means of the following relations

$$A = \frac{C' - C''}{n' - n''} \text{ and } b = \frac{C''n' - C'n''}{n' - n''}$$

where C', C'' and n', n'' the values given in the original article, for instance for bar stock, $C' = \$1{,}418$, $n' = 400$ pieces, $C'' = \$5{,}268$, $n'' = 2{,}000$ pieces, would give $A_1 = 2.406$, $b_1 = 0.448$.

—PAUL GRODZINSKI



DESIGNER'S DAYDREAM TOLD IN POEM

The following poem was contributed by J. A. Wittergreen, assistant superintendent of foundries, General Electric Company. It is reproduced here because of its possible interest to designers.

A DESIGNER'S MIND AT WORK

The designer bent across his board;
Wonderful things in his mind were stored,
And he said as he rubbed his throbbing bean,
"How can I make this tough to machine?

If this part here were only straight
I'm sure the thing would work first rate,
But 'twould be so easy to machine and bore
It never would make the machinist sore.

I'd better put in a right angle there,
Then watch those babies tear their hair.
Now I'll put the holes that hold the cap
Way down here where they're hard to tap.

This piece won't work, I'll bet a buck,
For it can't be held in a shoe or chuck;
It can't be drilled and it can't be ground;
In fact, the design is exceedingly sound."

He looked again and cried, "AT LAST
SUCCESS IS MINE! It can't even be cast."

—ANONYMOUS

OCTOBER EDITORIAL WINS READER'S PRAISE

To the Editor:

You have my heartfelt thanks for your editorial, "Only Might Will Guarantee Peace," in the October, 1944, number of PRODUCT ENGINEERING, page 669. I hope you will continue to emphasize this theme for, as you say, the pacifists are coming out of their shelters. I am sorry to admit that there were some in our own profession.

—CARROLL D. BILLMEYER

Meetings

Society of Automotive Engineers—Annual meeting, Jan. 8-12, Hotel Book-Cadillac, Detroit, Mich.

Institute of Aeronautical Sciences—13th annual meeting, Jan. 30-Feb. 1, New York, N. Y.

American Society for Testing Materials—Committee week and spring meeting, Feb. 26-Mar. 2, Hotel William Penn, Pittsburgh, Pa.

New Books

Heating, Ventilating Air Conditioning Guide

Published by American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York, N. Y. 22nd edition, 1,270 pages, 6x9 in., blue clothboard covers. Price $5.

Extensive revision and clarification has been done on this edition in order to include new material without expansion of text. Changes include complete revision and rearrangement of tables on heat transmission coefficients, simplification on fundamentals of heat transfer, new moisture permeability data for various materials, new data on fuels and the combustion process, the latest degree-day data compiled by the Weather Bureau, together with new data on predicting residence heat loss. Automatic fuel-burning equipment coverage is revised extensively and the section on expansion tanks is rewritten. New data on commercial pipe dimensions, improvement in presentation of cooling, dehumidification and dehydration, and changes in sound control data on fan noises, elbow attenuation and absorption for plate cells are included. The chapter on automatic control has been rewritten to present a fundamental approach to the subject and add new material. These and other changes make the 1944 edition more useful than previous editions.

Basic Mathematics For Engineers

P. G. Andres, H. J. Miser, and H. Reingold. 726 *pages, 5½x8½ in., blue clothboard covers. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price* $4.

Contains pertinent material from arithmetic, algebra, logarithms, trigonometry, and analytic geometry which is used in the solution of problems in elementary engineering and for beginning the study of calculus. Many illustrative examples are worked out in full so that the reader can see in operation the principles discussed in the text and will have a clear procedure after which to pattern his own work. Certain features of the book make it especially adapted for use by students of engineering. Principles of accuracy in numerical computations are continually emphasized. Graphical methods are stressed. A chapter on vector algebra is included. Graphs of the trigonometric functions are fully discussed. The Doolittle method of solving simultaneous linear equations is treated. Two introductory chapters on differential and integral calculus are included. The appendix contains a review of fundamentals of geometry with geometric formulas, also a collection of mathematical tables of data that have come to be widely used.

Chemical Machinery

Emil R. Riegel. 583 *pages, 6x9 in., green clothboard covers. Published by Reinhold Publishing Co., 330 W. 42nd St., New York 18, N. Y. Price* $5.

A collection of information on apparatus and devices used in the chemical industry is presented to acquaint college graduates in chemical engineering with practical problems of the chemical industry. The book is largely confined to equipment that has general application and that can be purchased from manufacturers. The treatment is primarily descriptive and is illustrated by more than 400 photographs, line drawings and charts. The arrangement is in order of events in chemical plants. Chapter headings start with plant location, devices for reducing the size of solid materials, screening and grading equipment, conveying and elevating equipment, and continue with a similar treatment of liquids with such subjects as mixing, kneading and blending, separation of solids from liquids, evaporators, crystallizers, driers, distilling and fractionating equipment, heat exchangers, pressure equipment and instruments. Although intended for college students, the book can be read with interest and profit by anyone desiring knowledge of the types of equipment used in chemical processes and their operation.

Mathematical and Physical Principles of Engineering Analysis

Walter C. Johnson. 346 *pages, 5¼x 8¼ in., blue clothboard covers. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 18, N. Y. Price* $3.

Essential physical and mathematical principles are discussed and correlated with methods for attacking the analysis and solution of a wide range of advanced problems encountered in the various fields of engineering. The author presents stratagems for planning the way to approach a problem. He shows how to use assumptions, to set up equations, to use mathematics as a tool, and to interpret mathematical results in terms of physical quantities. Included in the subjects treated are transient and steady-state conditions, graphical and numerical solution of differential equations, vector representation of sinusoids, the checking of equations, dimensional analysis, Fourier series, and systems with distributed constants. The scope of the text and supplementary problems is not confined to a single specialized branch of engineering, but covers many fields with which every graduate engineer should be familiar.

Experimental Stress Analysis

Proceedings of the Society for Experimental Stress Analysis. Vol. 1, No. 2. 132 pages, 8½x11 in., blue clothboard covers. Published by Addison-Wesley Press, Inc., Kendall Square Building, Cambridge 42, Mass. Price $4.

Collection of 15 papers contributed through the Society for Experimental Stress Analysis to the joint meeting held December, 1943, with the Applied Mechanics Division of the American Society of Mechanical Engineers. Titles of papers with respective authors are:

Transverse Impact Transients. C. O. Dohrenwend, D. C. Drucker, and P. Moore.

Some Aspects of Observing the Performance of Large Machinery under Operating Conditions. J. H. Meier.

Model Analysis of Structures. C. H. Norris.

Experiments on Combined Stress. J. Marin.

The Dyadic Gage. S. B. Williams.

Reducing Stress Concentration with Elliptical Fillets. D. C. Berkey.

Aircraft Static Testing and Its Relation to Stress Analysis. W. H. Bonnell.

The Bonded Wire Gage Torquemeter. A. C. Ruge.

Stress Measurement by X-Ray Diffraction. J. T. Norton and D. Rosenthal.

Applications of the X-Ray Diffraction Method of Stress Measurement to Problems Involving Residual Stresses in Metals. J. T. Norton and D. Rosenthal.

Design and Applications of a Magnetic Strain Gage. B. F. Langer.

Some Phases of Structural Research at Goodyear Aircraft Corporation. E. L. Shaw.

Strength Considerations in Bolt Fastening Design. C. Lipson.

Measurement of Strain in the Plastic Range. G. A. Brewer.

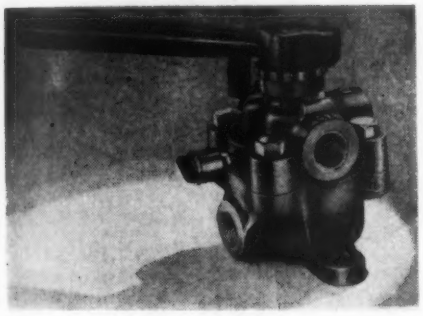
Application of the Brittle Lacquer Method in the Stress Analysis of Machine Parts. M. Hetenyi and W. E. Young.

NEW MATERIALS AND PARTS

Hydraulic Valve

Galland-Henning Mfg. Co., Milwaukee, Wis.

Developed specifically for ¾-in. hydraulic lines at pressures up to 300 lb. per sq. in., the Nopak ¾-in. hydraulic valve embodies such features as a cored disk, hand-lapped surfaces of disk and seat and line pressure-sealing and finger-touch control. In addition it incorporates a stuffing box with gland

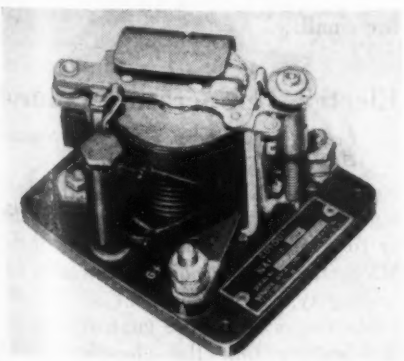


nut in the valve-stem assembly to prevent seepage at the valve stem. The valve is made of all-bronze construction, with lubricating channels in disc and seat, for water-hydraulic service, and in semi-steel, without lubricating channels, for oil-hydraulic service. It is available in hand, foot and solenoid models.

Reverse-Current Cutouts

Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.

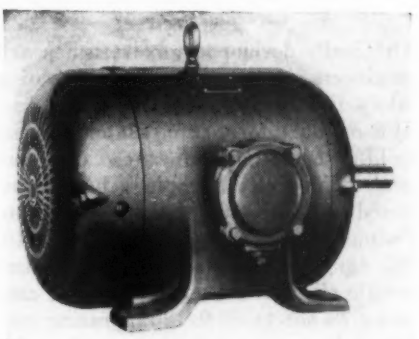
To prevent the reverse flow of current to generators in aircraft power systems that utilize batteries and generators as a power source, a reverse-current cutout automatically disconnects the generator from the electrical system when the generator voltage drops below the system voltage. The unit also operates as a generator automatic main switch. Available in four types, the cutouts operate on 25 or 100 current amp., 15 or 30 volts and function at 3 or 5 reverse-current amp. Weight is 0.82 or 1.63 lb. and sizes are 2$\frac{15}{16}$ x 2$\frac{15}{16}$ x 2¼in. or 3¼ x 3¾ x 2⅝ in. They operate in any mounting position when adjusted in that position. Changes in cutout temperature have little effect on operation. Silver-alloy contacts are provided and the adjustment knob is automatically locked.



Explosion-Proof Motor

Century Electric Co., 1806 Pine St., St. Louis 3, Mo.

Constructed to meet the specifications of and carry the label of Underwriters Laboratories, Inc., for Class I, Group C installations where ethyl ether-vapor is encountered, an explosion-proof motor is an addition to the manufacturer's

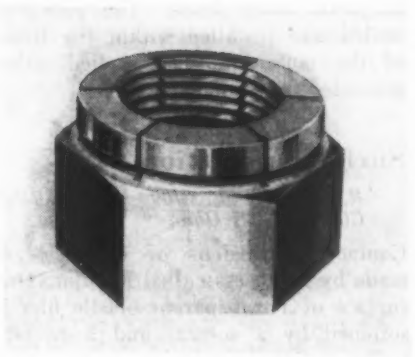


other motors of this type for other hazardous locations, which include the following: Class I, Group D, gasoline vapor; Class II, Group E, metal dust (magnesium); Class II, Group F, carbon black; Class II, Group G, grain dust.

Slotted-Section Lock Nut

Standard Pressed Steel Co., Jenkintown, Pa.

Consisting of a standard-size nut with the upper part slotted, the Flexloc lock nut depends on the flexibility and resiliency of these slotted sections for its locking action. This nut has previously

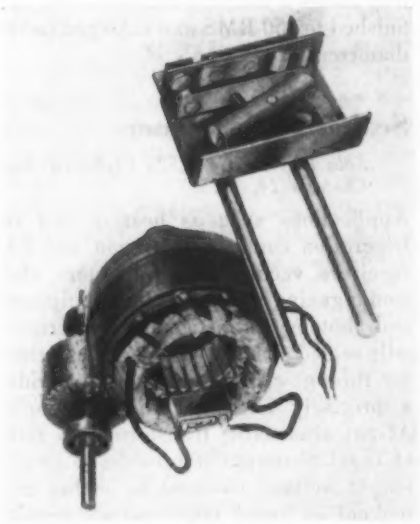


been limited to aircraft and ordnance applications. Because of the resilience of the slotted sections it is said that the nut can accommodate a wide range of tolerances without application torque varying greatly. It is available in National Coarse and National Fine threads and in sizes from #6-32 to ⅛ in the former and #6-40 to 1-14 in the latter.

Split-Phase Starting Switch

Motor Controls, Inc., 469 E. Ohio St., Chicago 11, Ill.

Performing the same functions as a conventional starting switch, a split-phase starting switch can be used on split-phase capacity start-induction run or capacity start-capacity run motors. It is activated by the magnetic field of the motor, drawing power from the stator through two iron poles. A flyer is mounted on a shaft so that when the poles are energized the flyer swings into

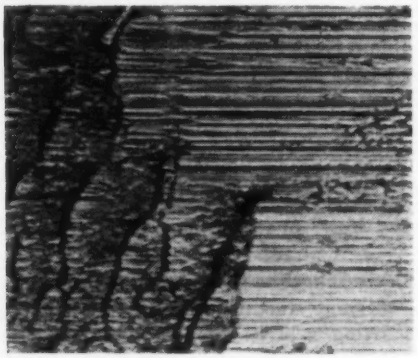


position like a compass needle. This swinging action makes the electrical contact that engages the starting winding. The cutout of the starting winding can be made to operate at any desired critical speed. A spring forces the flyer away from the pole pieces when the magnetic force drops. The switch is sealed and installed within the frame of the motor. It is supplied either grounded or insulated.

Surface Inspection

R. D. McDill, 5109 Mayfield Rd., Cleveland 21, Ohio.

Contact impressions of surfaces are made by a process called Faxfilm. One surface of a transparent plastic film is softened by a solvent and a contact replica of the surface is made. This film is then mounted in a cardboard frame that fits any standard projector for enlarging to 100 diameters or more. All contours of the surface are then



shown in three dimensions. The film can be filed for future record, if desired. The process requires less than a minute to make an impression, requires no complicated instruments and is relatively inexpensive. The illustration shows a machine-finished steel bar, finished to 250 RMS and enlarged to 100 diameters.

Sealed Transformer

Sola Electric Co., 2525 Clybourn Ave., Chicago 14, Ill.

Applications such as heating and refrigeration controls, television and FM receivers, vacuum-tube voltmeters, electronic gaging and inspection equipment and photometric instruments, a hermetically sealed constant-voltage transformer for through-chassis mountings provides a precisely regulated voltage supply. At any reasonable transformation ratio of input to output it provides a single-output voltage constant to within ±1 percent of rated requirements regard-

less of line-voltage variations as great as ±12 to 15 percent. Capacities up to 15 volt-amperes, 60-cycle operation are available and are supplied with a separate capacitor unit for external mounting. This transformer has no moving parts, requires no manual supervision or adjustments and is self-protecting against short circuit.

Sketching Blocks

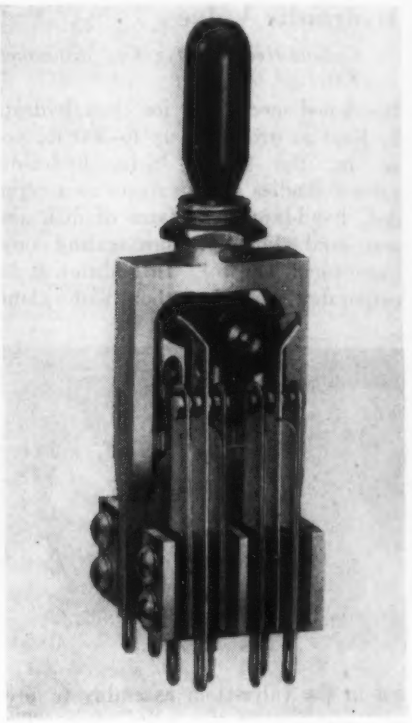
Craftint Mfg. Co., 210 St. Clair Ave., N. W., Cleveland, Ohio.

Originally developed for draftsmen and engineers in war work, a sketching block is now available for civilian use. It is intended for making sketches in the field and eliminates the need of rulers and T-Squares. The block has a patented non-slip cover with four separate "wings" that are imprinted with 1/10, ⅛, ¼, and ½-in. scales, plus an isometric chart over a ⅛-in. scale. It contains 75 sheets of 9x12-in. tracing vellum. Any one of the attached scales can be inserted directly beneath the tracing paper.

Cam Lever Switch

General Control Co., 1200 Soldiers Field Rd., Boston 34, Mass.

For aircraft and other light-duty applications, the Midget Model MCM cam lever switch is 2¾ x 1¼ x 1¼ in. and weighs 3½ oz. with 12 contact springs. Contact assemblies can be removed from the frame by removing a single bolt. All parts are corrosion resistant. The switch is balanced so that a positive roller action is obtained regardless of the number or arrangement of contacts on each side of the switch. Model MCM is rated from 5 to 10 amp., 125 volts a.c. and is available with either three positions or two positions, no neutral. A single hole is required for mounting and a locking key prevents the switch from turning in the mount.



Blackening Process

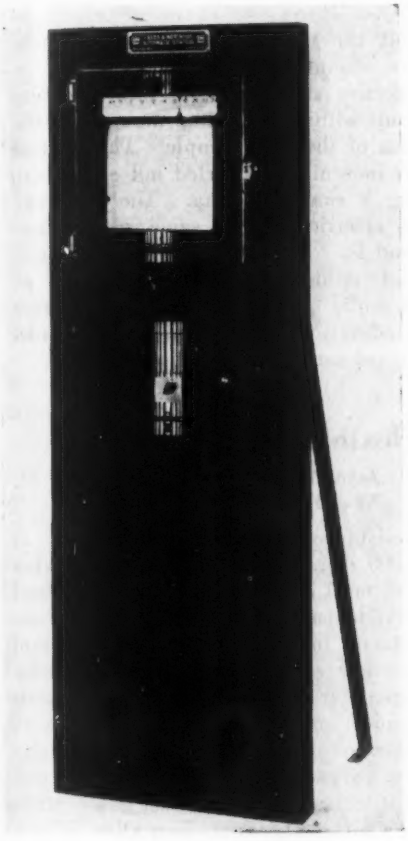
Turco Products, Inc., 6135 S. Central Ave., Los Angeles 1, Calif.

Utilizing simple immersion equipment, Ferrotoning is a chemical process for blackening ferrous parts. The bath operates at a relatively low temperature and requires only one solution tank. The gleaming black or rich matte finish is integral with the metal and resists chipping, flaking or peeling under repeated flexing. It also resists blistering and cleaning solvents or degreasing agents. Non-drying petroleum oils, rust-inhibiting lacquer or a synthetic-resin coating can be applied to the finish. Dimensional changes, if any, are small.

Electric Temperature Control

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Regulation of electric input to hold temperatures at a selected control point or to a program is the purpose of the Micromax electric control, duration adjusting type. By means of an "on-off" contacting system, the control feeds to the heating unit the electric current



needed to keep temperature to the required control point or program. Input is either "full-on" or "full-off." Regulation is obtained by controlling automatically the time during which current is "on" and "off." The unit provides automatic droop-correction. It can be equipped with overshoot control.

Lead Wire

Appliance & Merchandise Dept., General Electric Co., 1285 Boston Ave., Bridgeport 2, Conn.

For use in all types of fluorescent lamp ballasts, lead wire insulated with Deltabeston Flamenol thermoplastic insulation has been approved for service temperature up to 176 deg. F. The insulation is resistant to flame, aging, oils, acids and alkalies. This wire is available in solid and stranded conductors, sizes 16 and 18 AWG in black, white, red and green.

Decimal-Point Locator

Pickett & Eckel, 53 W. Jackson Blvd., Chicago 4, Ill.

Mechanical determination of the location of decimal point up to 19 places in involved expressions is one of the principal functions of the Deci.Point slide rule. It also gives 30-in. scale accuracy for cube root and 20-in. scale accuracy for square root. Synchronized scales permit reading of result, square root, cube root and log scales with one setting. The device is 11 x 2 x ⅛ in.

Post-Forming Laminate

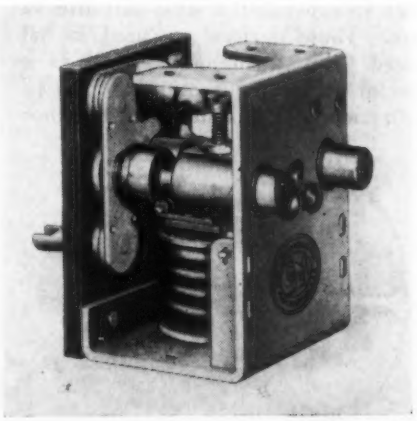
Taylor Fibre Co., Norristown, Pa.

Fabric-base phenolic fiber has been given greater elasticity by a special weave in the base material of the fiber and rearrangement of the resin formula and coating procedures to form Phenolastic fiber for post-forming laminates. The material can be formed within 3 min. to almost any bend, curve or draw desired. Among the advantages claimed are fast production, and lower die costs. A typical molded part is shown in the illustration.

Multi-Coil Circuit Breaker

G-M Laboratories, Inc., 4300 N. Knox Ave., Chicago 41, Ill.

Either a.c. or d.c. circuits can be protected with a multiple-coil circuit breaker that can be equipped with as many as three separate coil windings to make a single unit adaptable for protecting equipment that operates on different voltages. Time lag is short. Small size and light weight suit this unit for use on aircraft or other applications where space or weight is at a premium. In addition to acting as a resettable fuse, the breaker also serves as a manual switch because it has a push button. The respective windings may have a different number of turns and be of different size wire so proportioned that tripping can occur on overloads of three values in the range from a fraction of an ampere to 70 amp. Each winding has an independent terminal. Energy loss in the series circuit is low. The double silver contacts are brazed to silver-plated copper bars. A guide prevents the contact assembly from shifting. The breakers are usually adjusted to trip at twice the normal current value with a tolerance of ±25 percent. Weight is approximately 9 oz.



Electrode Holder

Lincoln Electric Co., Cleveland, Ohio.

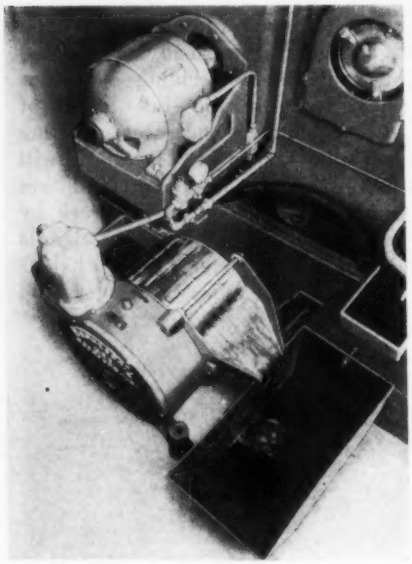
Having a current rating of 300 amp. with capacity for overload, an insulated holder will handle welding electrodes from ⅛ to ¼ in. dia. Jaws, made of high conducting and wear-resisting copper alloy known as "Lincalloy," will withstand rough treatment and are guarded from contacting the work by a spring-steel insulating guard that is replaceable. The trigger of the holder is of molded, heat-resistant inorganic material. Other features include hollow, air-cooled, heat-resistant fiber handle; balance; and good performance on both a.c. and d.c. The holder is designed to hold the electrode at any angle and permit easy change of rods.

Coolant Cleaner

Barnes Drill Co., Rockford, Ill.

Removal of metal and abrasive particles by magnetic attraction from honing coolants having a non-soluble base is the outstanding feature of the Barnes-driL magnetic-automatic chip separator. The separator is a self-contained, motor-driven unit employing a magnetic rotary drum which attracts metallic particles as they pass through the coolant and carries them out as the drum rotates. The drum is constructed of a series of permanent magnets mounted around the inside and rotating with it. The coolant flows rapidly in a channel through the lower part of the separator in a counter direction to the slow rotation of the drum. The metal and abra-

sive particles cling to the drum and, as the drum rotates, the sludge mass is scraped off into a movable pan. Constant swarf removal maintains reservoir storage. There is no temperature rise and the coolant returns to the reservoir in the base of the machine. Where gravity feed of the coolant from the machine to the separator is impracticable, a motor-driven pump can be used for transferring the used coolant into the separator. After the coolant is cleaned it is carried by gravity from the separator to the coolant reservoir. The separator can be used on machines where minute particles of magnetic material are suspended in a coolant, such



as vertical and horizontal honing machines and grinding machines when a soluble solution is used as the coolant. Two sizes of the separator, both employing a ¼-hp. motor, are now available. Capacity of the smaller is 10 gal. per min., while the larger size will handle 20 gal. per min. Weight of the smaller size is 500 lb., and of the larger, 600 lb.

Photographic Paper

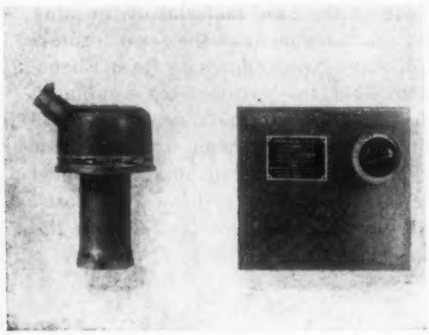
Peerless Photo Products, Inc., 50 Broadway, New York, N. Y.

Photographic reproductions can be made on either paper or translucent vellum with blueprinting machines by using Photo-Arc papers. No darkroom or special printing equipment is needed because of the tolerance of the paper to ordinary artificial light. Blueprints, drawings or tracings can be copied and high-contrast, litho-type paper negatives can also be made. The paper is said to have anti-diffusion characteristics which improve definition.

Liquid-Level Control

Hancock Valve Div., Manning, Maxwell & Moore, Inc., Bridgeport 2, Conn.

Automatic control of liquid level to within a fraction of an inch is the function of a recently announced electric float device. No switches or con-



tacts are inside or outside the float chamber and there are no levers, linkages, bellows, stuffing boxes, cooling fins, mercury switches or wearing parts. The level of the liquid can be raised or lowered by adjusting a screw.

Welding Electrodes

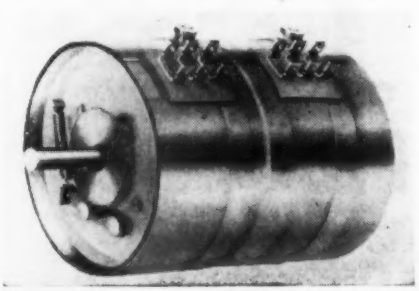
Welding Equipment & Supply Co., 223 Leib Street, Detroit 7, Mich.

Addition of two welding electrodes to the Eureka line has been announced. One is a molybdenum high-speed steel electrode producing weld deposits at 60-64 Rockwell C hardness. The other is a hot-work tool-steel electrode producing carbon-molybdenum-chromium deposits having abrasion resistance at high heat with Rockwell C hardness of 58-62.

Dual-Unit Attenuator

Daven Co., 191 Central Ave., Newark, N. J.

Features of standard single-unit attenuators and new innovations have been incorporated in dual-unit attenuators. These devices are used in balanced "H" attenuators as well as in special multi-circuit controls of the potentiometer, "T", ladder, "L", and rheo-

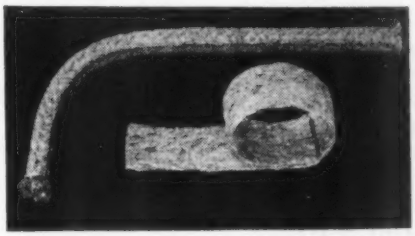


stat types. Comprised of two units, one mounted behind the other, the respective shafts of each meet in a lap joint within a bushing, making separation of the units simple. This is done by loosening a knurled nut and releasing a snap-on fitting. The dual unit is electrically the same as previous models. In addition, it has fungus- and mildew-resistant varnish on all phenolic plastic parts and resistance windings. Contact and switch blades are of tarnish-resistant silver alloy.

Flexible Metallic Packing

Johns-Manville Corp., 22 E. 40th St., New York 16, N. Y.

Resistance to temperatures up to 2,000 deg. F., corrosive gases, alaklies and most acids are features of Inconel flexible packing. It was originally developed for use in exhaust systems of airplane engines equipped with turbo-superchargers. In this service, flexible connections are necessary to absorb vibration between stationary and moving parts and at the same time prevent leakage of the exhaust gases. Made of a nickel-chromium-iron alloy in wire form the packing is first knitted into mesh and then braided. As a result,



the packing is resilient, non-scaling and non-magnetic. It is available in a number of styles, including square sections in coil and tape forms, from which ring-type gaskets can be made. One style is made with interwoven asbestos fibers to serve as a sealing agent.

High-Tensile Electrode

Electric Welding Div., General Electric Co., Schenectady, N. Y.

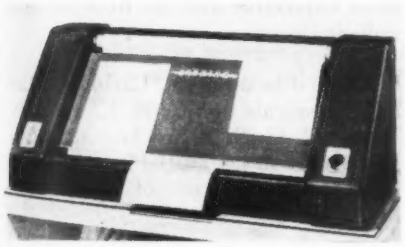
For fabricating aircraft steels by arc welding, an electrode has been announced that is capable of making a deposit of tensile strength that is comparable to the mechanical properties of the parent metal. Known as Type W-55, the electrode is especially designed for use in the manufacture of heavy bombers and transport planes. It can be used for welding in any position, including vertical welding from the top down and from the bottom up. Arcing characteristics provide flexibility over a fairly

wide voltage range with stable operation throughout. The arc has sufficient force to keep slag from crowding the electrode when welding vertically downward, and the metal sets up quickly when welding overhead and vertically upward. Characterized by a grey extruded coating, the electrode is recommended for operation on straight polarity d.c. or a.c. A medium-to-long arc is recommended for best results. The electrode is available in three sizes—3/32 x 12, 1/8 x 14, and 5/32 x 14 in.

Continuous Printer

Charles Bruning Co., 4700 Montrose Ave., Chicago 41, Ill.

Anything drawn, typed, printed or illustrated can be duplicated and black-and-white prints can be made on the BW-Copyflex Model 2 continuous



printer. Either side or both sides of original material can be reproduced. The printer fits in desk-top space. It exposes roll stock or cut sheets up to 24 in. wide at 5 to 30 in. per min.

Resistors

Instrument Resistors Co., 25 Amity St., Little Falls, N. J.

Protection against deterioration and resultant failure in tropical or humid locations is provided in Tropi-Pruf resistors. Each component is inclosed in a phenolic plastic case. After dehydration the resistor is sealed and fitted with an accurately machined cap. Leads are bare at the point of entrance through the case and are sealed with a special compound. A No. 6-32 mounting screw is an integral part of the housing. The completed unit has a special fungacidal coating that is non-toxic, meets Signal

Corps Specification No. 71-2202-A and is effective for about one year. The resistors are available in a diversity of resistance values and wattage ratings. Accuracy tolerances suitable for either general or precision applications are available.

Rubber-Metal Adhesive

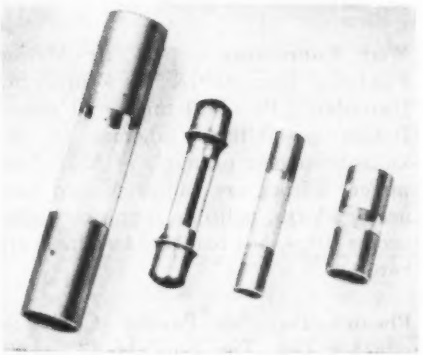
Firestone Tire & Rubber Co., Akron, Ohio.

Development of an adhesive for bonding synthetic rubber to metal, and for which is claimed a bonding strength hitherto unattained, has been announced. Brass plating of metals before bonding is eliminated and, in addition, more uniform adhesion than is possible with brass plating is provided. The cement is said to be unaffected by spots of water or rust film.

Glass Plating

Electro Plastic Processes, 2035 W. Charleston St., Chicago 47, Ill.

Adaptation of an electroplating process for plastic materials to the coating of glass and ceramics has been announced. By means of this process a metallic band can be applied which can then be used for soldering to metallic



end caps or insulators plated for solder sealing to metallic containers. The process is adaptable to the hermetic sealing of such electrical components as resistors, condensers, small relays, transformers and instruments. Tests on Pyrex glass have been conducted by heating a solder-sealed piece to 350 deg. F. and immediately immersing it in solidified carbon dioxide, with satisfactory results.

Barrel Deburring

De-Burr Barrel Co., 4759 Hollywood Blvd., Los Angeles 27, Calif.

Abrasive pieces made of Neoprene impregnated with aluminum oxide particles and a special barrel are the principal components of the De Burr process for removing burrs. The barrel is octagon shaped, has a 40-in. dia. and 16-in. width and is lined with ¼-in. thick abrasion-resistant Neoprene. The abrasive compound, called De-Burrettes, is made of a Neoprene base because this material acts as a cushioning agent for the parts and serves as a flexible mounting for the abrasive praticles. This provides an action similar to honing. The flat sides of the barrel add to this action by causing the De-Burrettes and parts to slide over each other. The barrel turns at any rate from 8 to 22 r.p.m. Barrell speed, time of running and ratio of parts to De-Burrettes depend on the parts, the material from which they are made and the finish desired.

Fastener Grommet

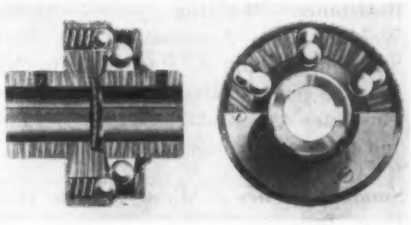
Camloc Fastener Corp., Graybar Bldg., New York 17, N. Y.

Use on all short thicknesses is the feature of a grommet that replaces seven different grommets previously needed to handle the same range for the Camloc Series 4002 quick-acting fastener. Made of steel, the grommet is flush mounted and is permanently secured in the panel. A preformed flange on the outside gives uniform strength characteristics irrespective of the type of installation.

Automatic Coupling

A. Y. Dodge Co., 307 S. Main St., Rockford, Ill.

Embodying self-aligning and flexible features, an automatic coupling releases completely when overloaded and engages automatically when the power is shut off. It has an undulating cam and six interlocking drive balls that automatically disengage when overloaded. Excess torque on the cam forces the drive balls out of the cam grooves by overcoming the force exerted by the spring-loaded balls. The drive balls are held in the disengaged position by



centrifugal force. Five standard sizes are available ranging in outside diameter from 2⅜ to 6¾ in., over-all length from 2¼ to 6½ in., horsepower rating from ⅓ to 8 and torque rating from 4 to 72 lb. ft. Couplings are designed to operate at speeds above 800 r.p.m. At slower speeds they partially release. Special models are also available.

Manufacturers' Publications

Gears—Illinois Gear & Machine Co., 2108 N. Natchez Ave., Chicago 35, Ill. Catalog 39, 64 pages. Beside describing gears made by the company this publication contains general information on symbols used in designating gear parts, formulas for computing the horsepower of various gears, factors for determining the strength of gear teeth and other gear application data.

Speed Reducers — Philadelphia Gear Works, Erie Ave. and G. St., Philadelphia 34, Pa. Bulletin 200, 56 pages. Covers design features, selection, load characteristics, service factors, horsepower ratings, capacities, weights and dimensions of spiral-bevel speed reducers.

Name Plates—Robbins Co., Attleboro, Mass. Bulletin, 4 pages. Illustrates several typical name and data plates and medallions designed by the company.

Flexible Shafts—Industrial Div., S. S. White Dental Mfg. Co., 10 E. 40th St., New York 16, N. Y. Book, 256 pages. Second edition of this handbook, it covers flexible shafts and their application for power drives, remote control and coupling.

Transfer Paper—Eastman Kodak Co., Rochester 4, N. Y. Booklet, 20 pages. Describes the photographic preparation and reproduction of templates.

Copper-Base Alloys—Bridgeport Brass Co., Bridgeport 2, Conn. Manual, 80 pages. Contains specifications and technical data on five Duronze corrosion-resistant, high-strength copper-base alloys.

Resistance Welding — Resistance Welder Mfrs. Association, 505 Arch St., Philadelphia 6, Pa. Bulletin No. 101, 32 pages. Describes briefly and illustrates types of resistance welding and their applications.

Small Switches — Micro Switch Div., First Industrial Corp., Freeport, Ill. Handbook catalog No. 71, 100 pages. Heavy-duty types of Micro Switches and auxiliary devices for electrical controls in aircraft, automotive, marine, railway and heavy-machinery applications are described and illustrated.

Steel Plate—Lukens Steel Co., Coatesville, Pa. Slide calculator. Theoretical weight of steel plate from 10 to 200 in. wide and ⅛ to 6 in. thick, and the longest and widest plate obtainable for any desired thickness can be calculated.

Meehanite—Meehanite Research Institute of America, Inc., Pershing Square Building, New Rochelle, N. Y. Bulletin No. 21, 4 pages. Typical applications of special heat-resistant Meehanite castings are illustrated and various property data are tabulated.

Speed Reducers—Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill. Book No. 1824, 96 pages. Selection data for industrial applications of speed reducers are presented in the form of photographs and line drawings, horsepower ratings, tables of weights and dimensions and other pertinent engineering data.

Glass Fibers—Owens-Corning Fiberglas Corp., Toledo 1, Ohio. Catalog No. EL4407, 24 pages. Properties, types available, uses and selection factors of all forms of Fiberglas used for electrical insulation are given.

Wire Connectors — Aircraft-Marine Products, Inc., 1591R N. Fourth St., Harrisburg, Pa. Bulletin 33, 20 pages. Design possibilities inherent in the knife-disconnect principle of AMP Simplified Wiring are indicated and connector blocks, multiple connectors, connector strips, bus bars and terminals are covered.

Plastics—Hercules Powder Co., Wilmington, Del. Two booklets, 48 and 24 pages, respectively. First booklet covers properties and uses of ethyl cellulose, including considerable technical data; second, entitled "Ethyl Cellulose Formulations with Resins and Plasticizers," was prepared for those interested in making practical use of ethyl cellulose.

Insulation—Resin and Adhesive Materials Div., General Electric Co., Schenectady 5, N. Y. Bulletin, 12 pages. Contains reprint of article from *General Electric Review* describing formation of an organo-silicon film and its effects on electrical properties of insulators.

Sheet Steel—American Rolling Mill Co., Middletown, Ohio. Bulletin, 12 pages. Paintgrip, a cold-rolled sheet steel with surface especially treated to take paint, is covered so far as physical properties, corrosion resistance, paint life, forming limitations, welding and applications for various products are concerned.

Relays and Solenoids—Dept. S-R, Guardian Electric Mfg. Co., 1629 W. Walnut St., Chicago 12, Ill. Bulletin S-R, 4 pages. Details and operating characteristics of eight relays and eight solenoids are presented.

Casting Alloys—Sterling Alloys, Inc., Woburn, Mass. Bulletin No. 200, 16 pages. Covers various heat- and corrosion-resistant casting alloys, their allowable design stresses and typical applications.

Seamless Tubing — Tube Reducing Corp., Wallington, N. J. Bulletin, 16 pages. Basic information about the principal methods used to size hot-rolled tubing is presented, including a discussion of customary tolerances and those obtainable with the Rockrite tube-reducing process.

Plastics—Plastics Div., Carbide & Carbon Chemicals Corp., 30 E. 42nd St., New York 17, N. Y. Brochure, 12 pages. Properties, forms available, fabrication procedures and uses of polyethylene resins are described.

Shot Peening — American Foundry Equipment Co., Mishawaka, Ind. Booklet, 24 pages. Contains technical discussion entitled "Shot Peening and the Fatigue of Metals," by H. F. Moore, research professor of engineering materials, emeritus, University of Illinois.

Sponge Rubber—B. F. Goodrich Co., Akron, Ohio. Catalog Section 9790, 2 pages. Gives uses, sizes and weights of milled sponge rubber made of either synthetic or reclaim rubber.

Coating — Amercoat Div., American Pipe & Construction Co., P. O. Box 3428, Terminal Annex, Los Angeles 54, Calif. Bulletin, 4 pages. Describes uses, features and advantages of Amercoat No. 23, a general-purpose cold-applied plastic coating.

Control—Askania Regulator Co., 1603 S. Michigan Ave., Chicago 16, Ill. Bulletin No. 120, 4 pages. Describes the Askania Power Unit, designed to extend the range of uses for air-operated controllers.

Finishes—Bakelite Corp., 30 E. 42nd St., New York 17, N. Y. Booklet, 28 pages. Types of surfaces that can be coated, methods of application, baking methods and equipment, properties and applications of phenolic-resin baking coatings are covered.

Fillets for Stepped Shafts In Repeated or Reversed Torsion

ARTHUR M. G. MOODY
Chief Research Engineer, De Laval Steam Turbine Company

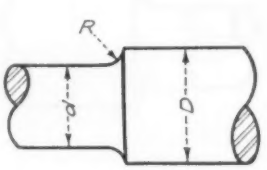
STRESS CONCENTRATIONS at the shoulders of stepped shafts are of primary importance when the shafts are subjected to repeated or reversed loads.

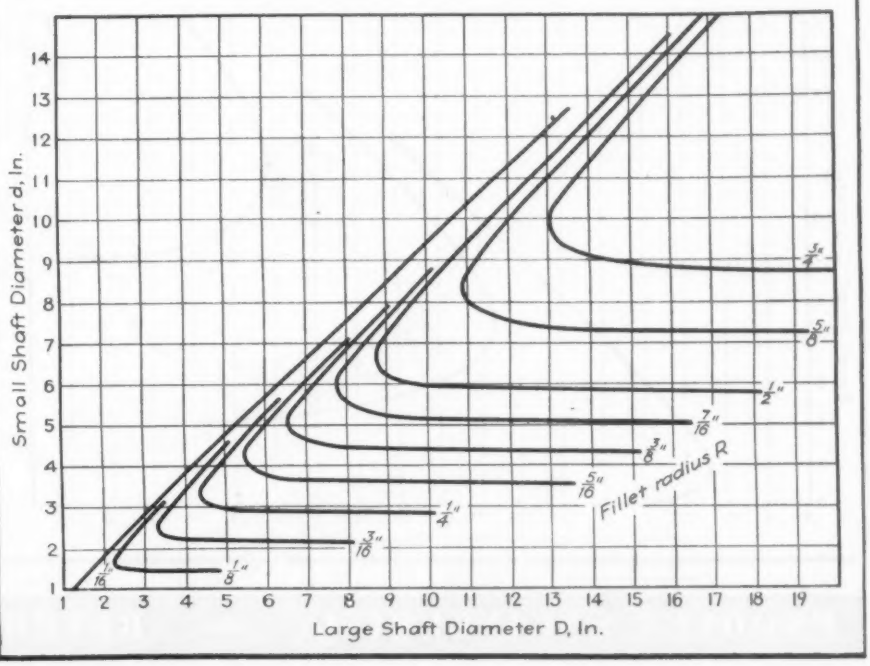
The accompanying curves give the fillet radius to use to obtain stress concentration factors of 1.5, 2.0, 2.5, and 3 for various combinations of diameters in stepped shafts. The stress concentration factor is the ratio of the maximum stress at the fillet to the nominal stress as calculated by the simple conventional torsion equations.

The data on which these curves are based were first published in the A.S.M.E. *Transactions*, Vol. 47, 1925, p. 619, by L. S. Jacobsen. Jacobsen's data also appears in Timoshenko's "Strength of Materials," p. 335. The same information can be found in the A.S.M.E. publication "Design Data-Applied Mechanics, Book I."

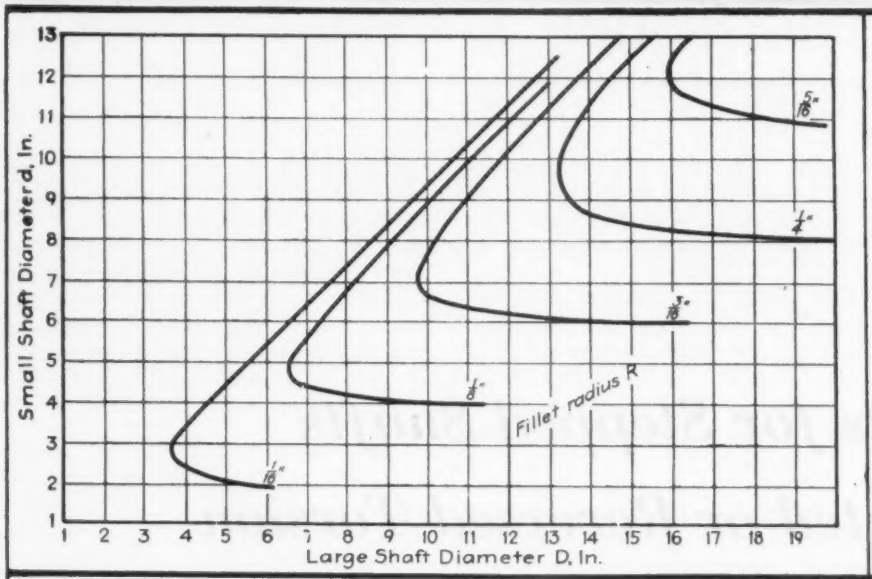
FILLET PROPORTION FOR STEPPED SHAFTS

For Stress Concentration of 1.5



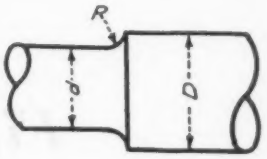


Fillets for Stepped Shafts (continued)



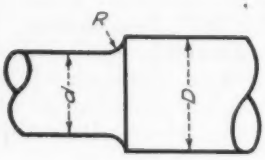
FILLET PROPORTION FOR STEPPED SHAFTS

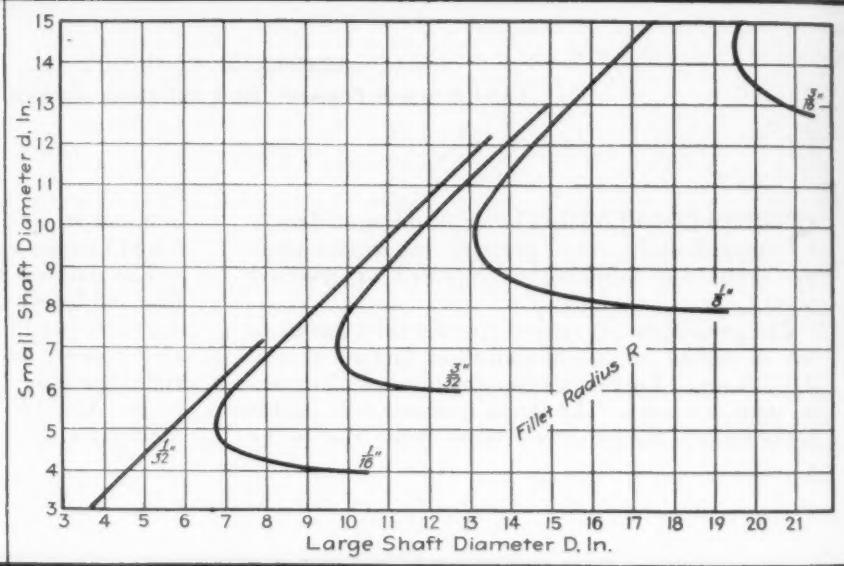
for Stress Concentration of 2.0

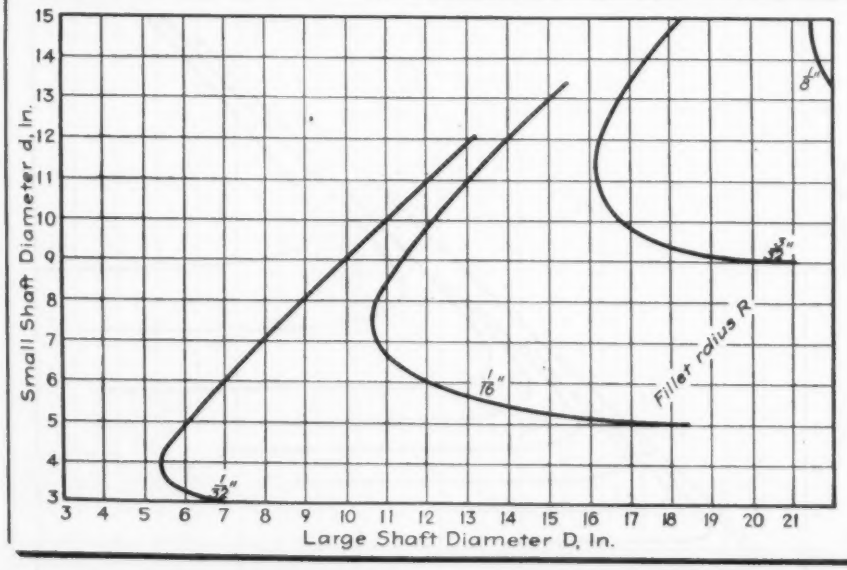


FILLET PROPORTION FOR STEPPED SHAFTS

For Stress Concentration of 2.5

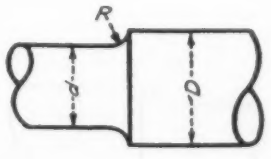






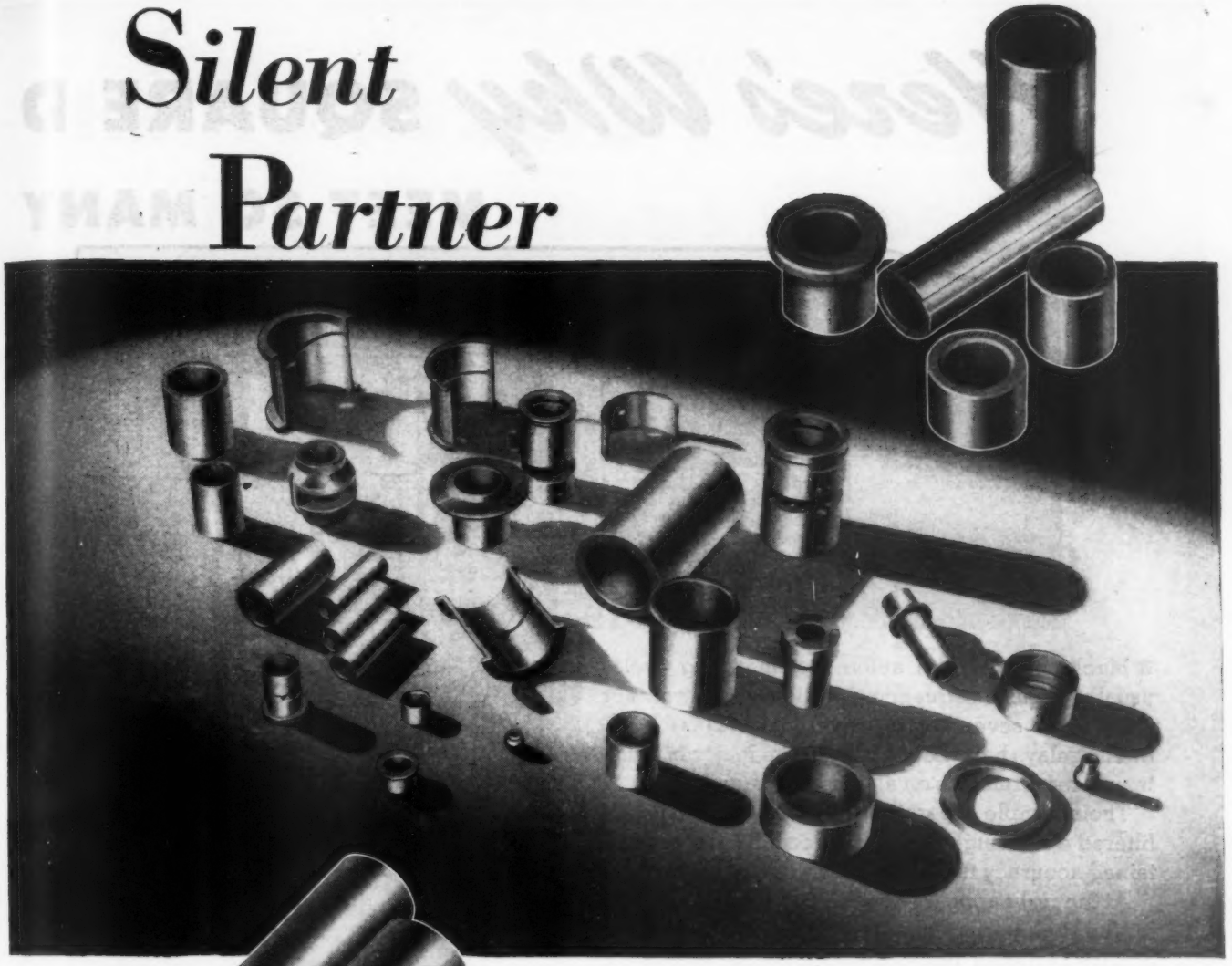
FILLET PROPORTION FOR STEPPED SHAFTS

Stress Concentration of 3.0



PRODUCT ENGINEERING — REFERENCE BOOK SHEET

Silent Partner



of Performance

QUIET operation is a strong selling point for all types of household appliances. One easy way to eliminate noise is to install Johnson Bronze Sleeve Bearings in the motive unit. They are precision made products, guaranteed to deliver the utmost in performance for the longest period of time.

Manufacturers giving thought to their postwar product will do well to consult with Johnson Bronze now. Simply call in a Johnson Engineer. Permit him to review your applications. All of his recommendations will be based on facts, supported by more than thirty-five years exclusive bearing experience. There is a Johnson Engineer—as near as your phone.

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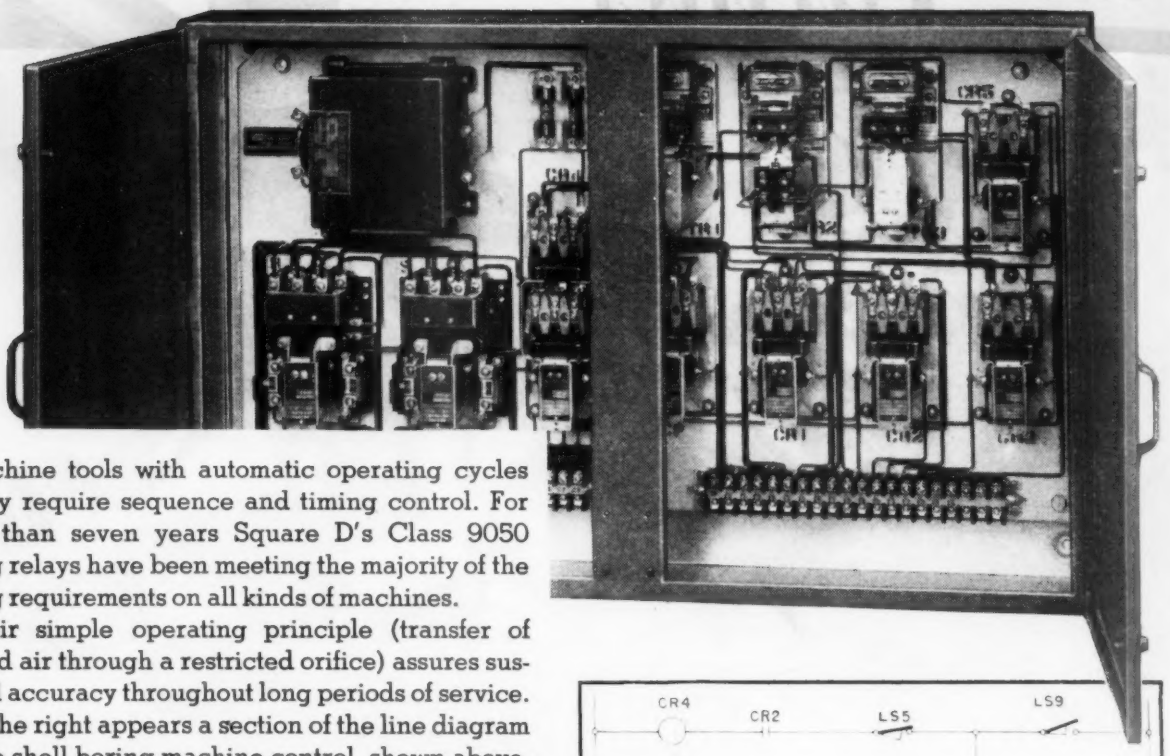
Here's Why SQUARE D MEET SO MANY



● Machine tools with automatic operating cycles usually require sequence and timing control. For more than seven years Square D's Class 9050 timing relays have been meeting the majority of the timing requirements on all kinds of machines.

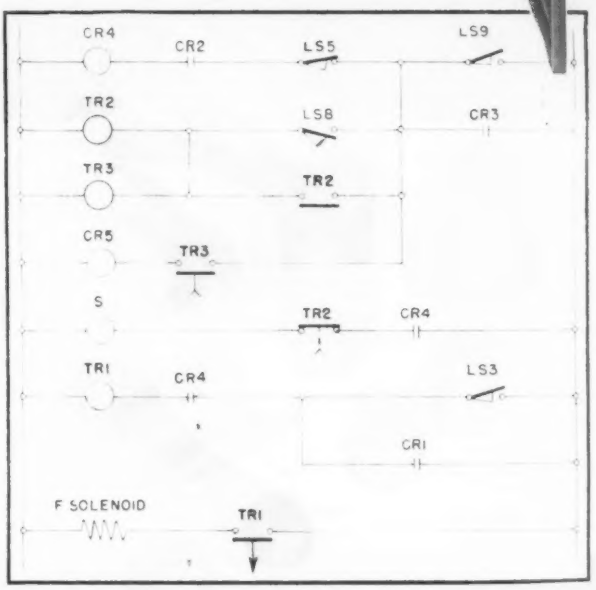
Their simple operating principle (transfer of filtered air through a restricted orifice) assures sustained accuracy throughout long periods of service.

At the right appears a section of the line diagram for the shell boring machine control, shown above. Square D timing relays afford a simple means for controlling three essential delay periods in the automatic indexing and boring cycle. Note how the instantaneous operating interlock contacts on TR-2 eliminate the need for an additional relay. Tabulated below are the four basic timing relay functions and corresponding diagram symbols.

SQUARE D COMPANY, Industrial Controller Division
Milwaukee 12, Wisconsin

FUNCTION	SYMBOL
TIME DELAY AFTER ENERGIZING COIL BEFORE CONTACT IS CLOSED	
TIME DELAY AFTER ENERGIZING COIL BEFORE CONTACT IS OPENED	
TIME DELAY AFTER DEENERGIZING COIL BEFORE CONTACT IS CLOSED	
TIME DELAY AFTER DEENERGIZING COIL BEFORE CONTACT IS OPENED	

Note: **CLASS 9050 TYPE R TIMERS** for A. C. service have SPDT contacts so that only two standard types are needed to cover the four possible functions.



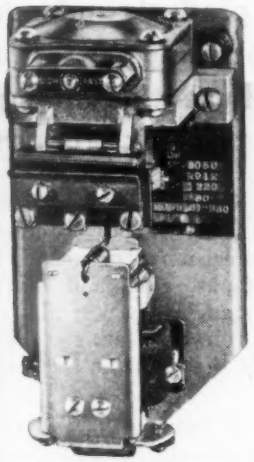
TR-1 keeps F solenoid energized to hold back fixture locking pin during initial portion of indexing motion.

TR-2 is energized at end of feed travel. After time delay TR-2 contacts open to stop spindle and coolant pump. Dwell period, while TR-2 is timing out, is required to clean up the hole and remove chips before retracting the boring head. Interlock on TR-2 acts as holding circuit to keep TR-2 and TR-3 energized after boring head backs off limit switch LS-8.

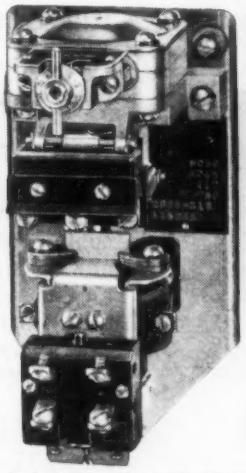
TR-3 is energized at the same time as TR-2. After its timing period is completed, relay CR-5 is energized. CR-5 controls a solenoid which provides rapid traverse return of boring head to retracted position.

TIMING RELAYS
MACHINE TOOL TIMING NEEDS

● Timing relays with their own operating magnets are available for either A. C. or D. C. operation. An additional double circuit electrical interlock can be attached to the relay magnet to operate without time delay. Micrometer-type adjusting dials are furnished if desired. For added convenience and economy, individual self-contained units can be furnished for those applications which permit operation through a mechanical linkage to a magnetic contactor on the machine tool control panel. The pneumatic timing units can be attached easily and quickly to A. C. or D. C. contactors for this type of service.

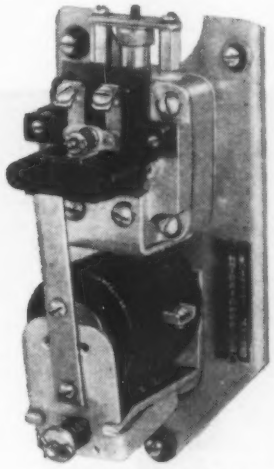


A.C. timing relay for delay after energization.

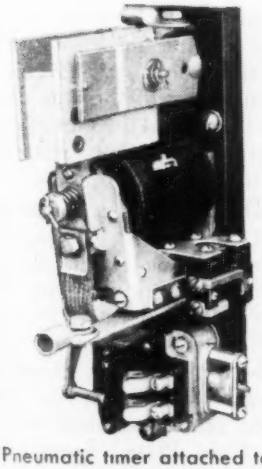


A.C. timing relay with micrometer dial and electrical interlock. Delay after de-energization.

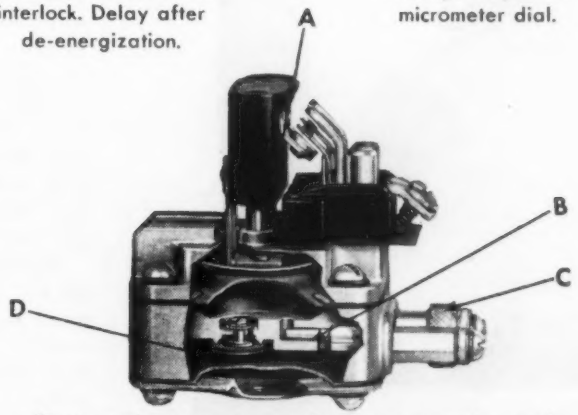
New flush mounting A.C. timing relay with micrometer dial.



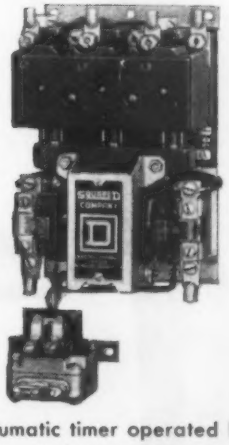
D.C. timing relay. Delay after de-energization.



Pneumatic timer attached to D.C. contactor.



Timer mechanism cutaway showing construction and method of operation. Spring action (A) moves contact member as quickly as air can transfer from lower to upper chambers through the restricted orifice (B). Turning the knurled wheel (C) regulates amount of restriction. A check valve (D) allows instantaneous resetting.



Pneumatic timer operated by A.C. contactor.

SQUARE D COMPANY

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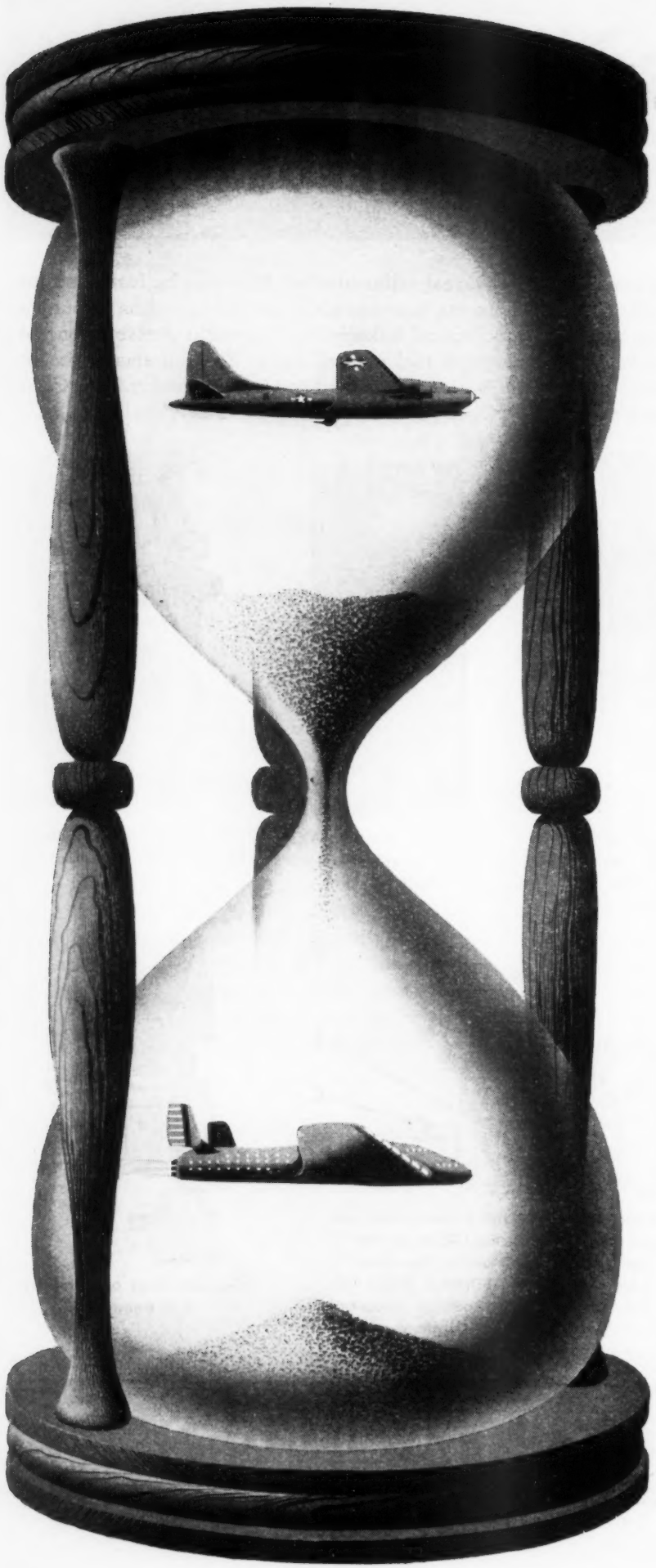

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Industrial users of WILCO Products will find the increased facilities, the new products and techniques developed by WILCO for war service of great advantage to their own postwar products.

As the Hourglass indicates . . . with the coming of peace, many WILCO products now making for precision performance in airplanes, ships, tanks, guns and instruments of the Army and Navy will play an equally important role in meeting civilian needs for hundreds of useful and reliable products.

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KH-45

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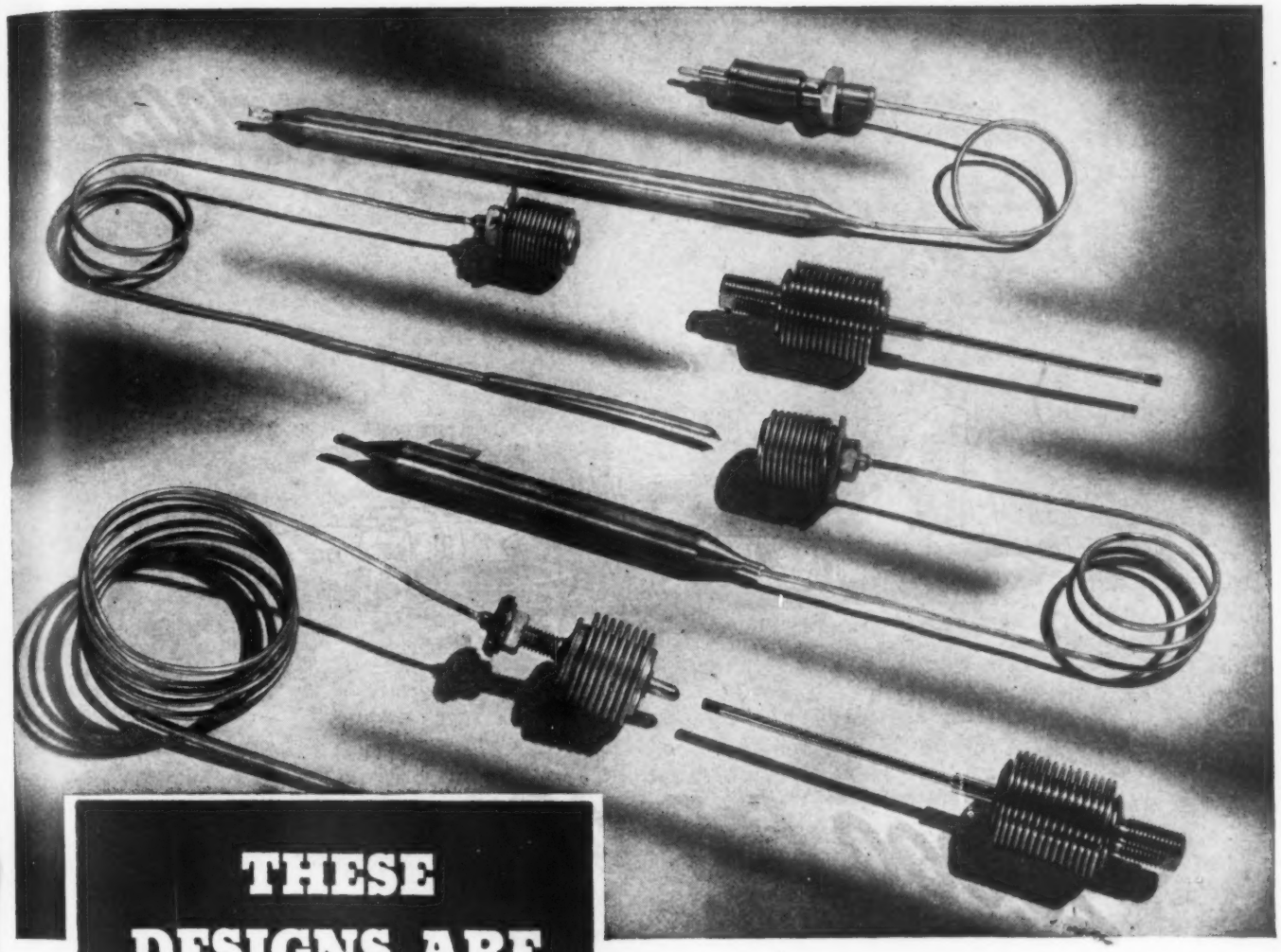

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For the engineer designing equipment where temperature control is a factor, Fulton Sylphon Thermostat Assemblies are a wise choice. Their flexibility of design adapts them to practically any type of equipment, and their simple, compact ruggedness is assurance of long, service-free operation.

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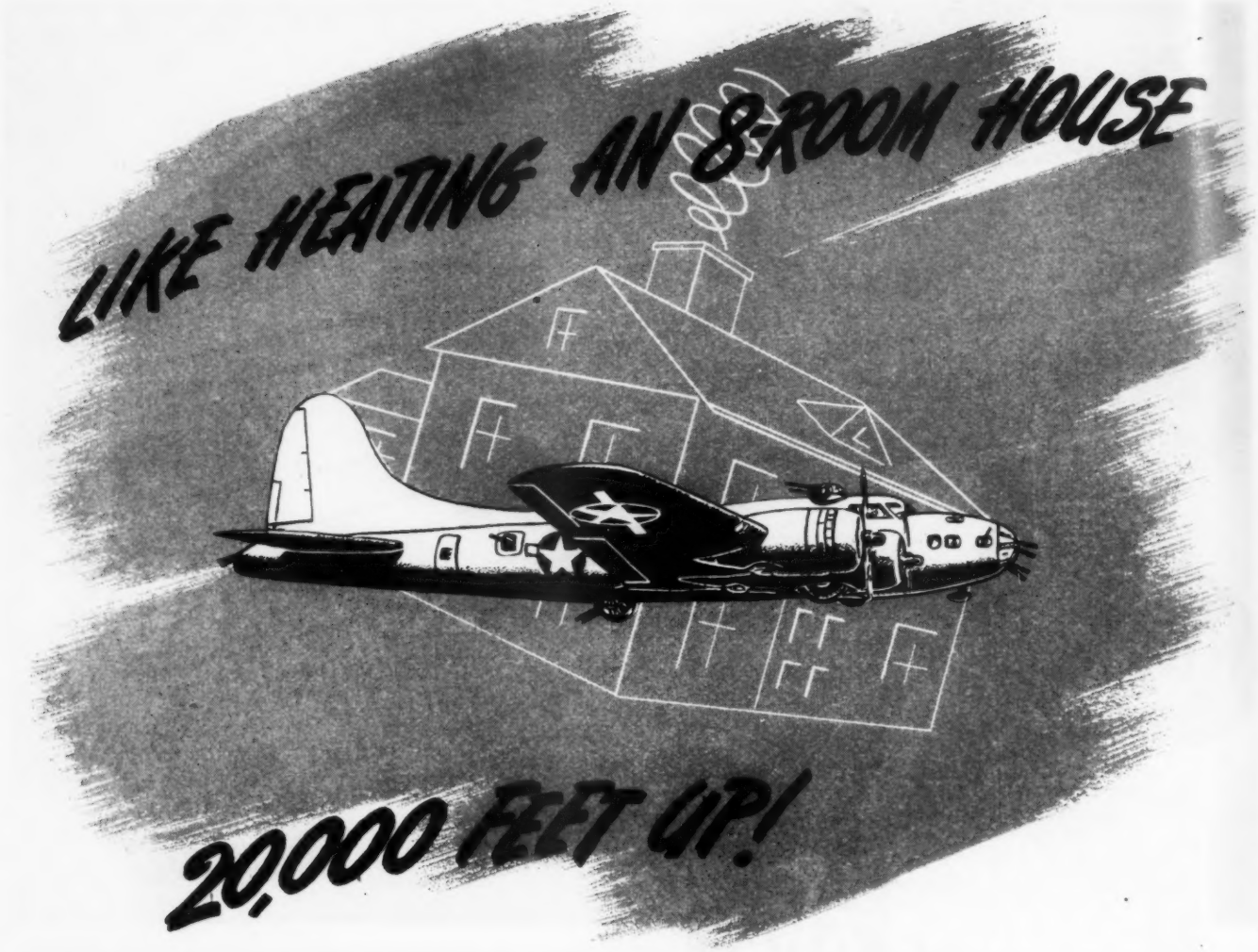

Callite Contacts used in the Thermoswitch of a flying furnace . . .

Stewart Warner South Wind Heaters—midget "flying furnaces" in the wings of our combat planes—produce more heat than the furnace for an 8-room house.

Callite Silver Contacts are vital parts of the Fenwal Thermoswitch used in the control unit of South Wind Heaters. Fenwal Inc. of Ashland, Mass., manufacture the South Wind Thermostich overheat control in these amazing skyborne furnaces. Callite Silver Contacts' high electrical and thermal conductivity and trouble-free long life make them ideal for this application. Callite produces a multitude of other contact types which represent close cooperation between our engineers and product designers and manufacturers Consult us on your requirements.

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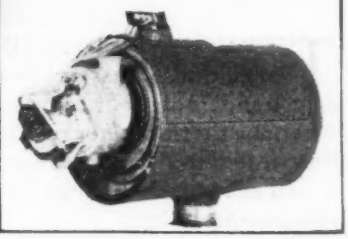
The Fenwal Thermoswitch, control unit for South Wind Heaters, uses Callite Silver Contacts



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Discuss your plans for post-war products with a C-T development engineer. We can help on design and materials . . . especially metallurgical components.

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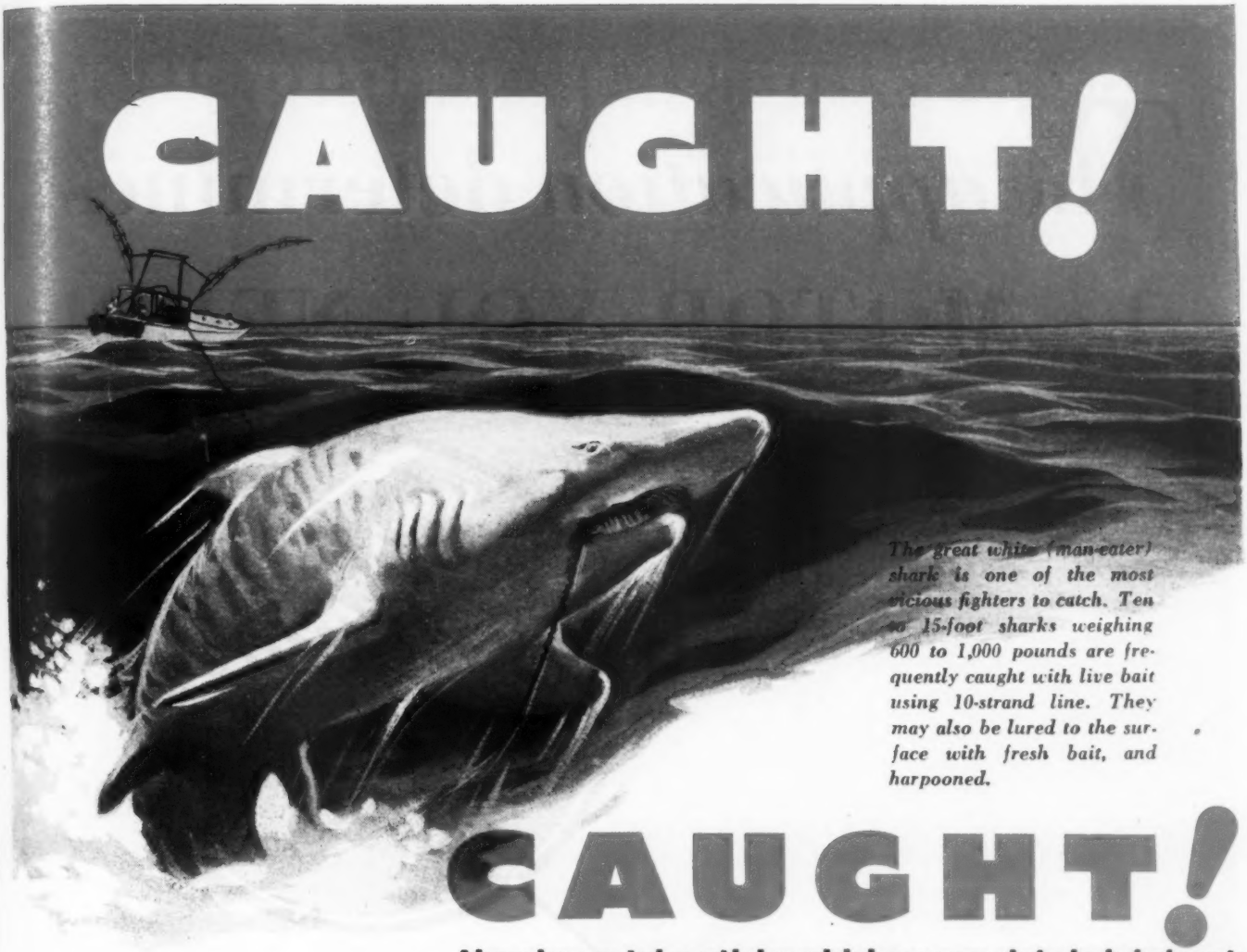
CAUGHT!



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—Abrasive metal particles which accumulate in lubricants

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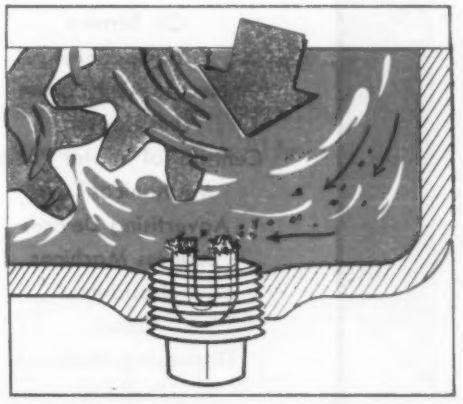
Through normal wear, abrasive metal particles naturally form in the lubricant of any product. These metal cuttings grind away at gears, bearings, and all surfaces they contact—cause added wear and premature failure. Lisle Plugs stop this cause of excessive wear. A powerful magnet anchored in the Lisle Plug contacts the lubricant, CAPTURES the abrasive metal as fast as it forms—HOLDS this metal until it is wiped off at inspection time. Result: longer product life.



Specify Lisle MAGNETIC Plugs instead of ordinary drain plugs in your products, as many other companies are doing. *Engineers, Designers — write today for sample plug for testing, and illustrated catalog.*

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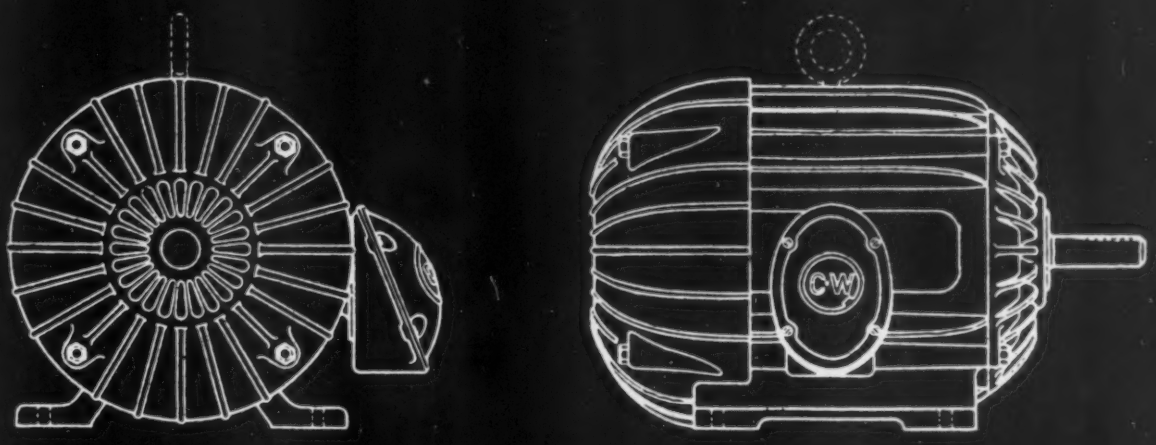

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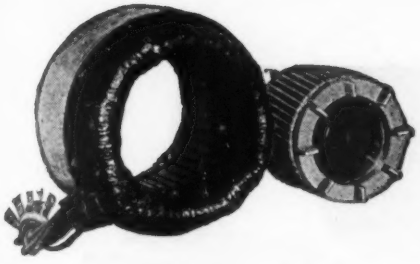

These partial motors employ the same high grade vacuum impregnated insulation, rotor and stator construction that are inherent in the C-W standard squirrel caged machines. These motors are available from 208 to 550 volts, 2 or 3 phase, to 150 horsepower at 3600 r.p.m.

WHEN PEACE IS MADE—be prepared to produce that planned post-war product with adequate, dependable Crocker-Wheeler power. Our facilities and expert engineering knowledge will help you work out tomorrow's power system.

You will find efficiency and longer life in the pictured C-W squirrel cage SEALEDPOWER motors. Complete data on C-W AC Motors, DC Motors, AC Generators, DC Generators, Turbo-Generators, and Couplings is available at our nearest C-W office.

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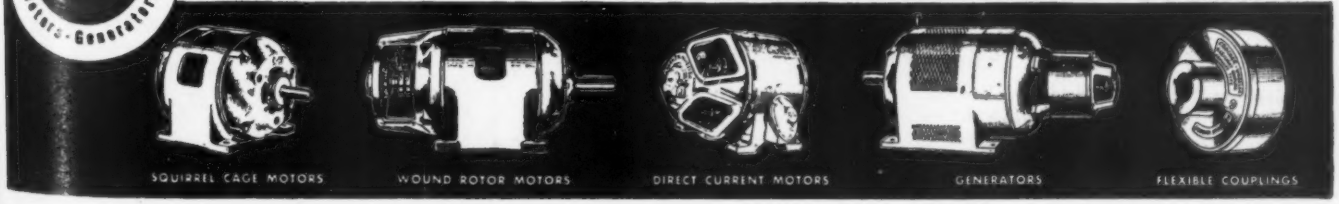

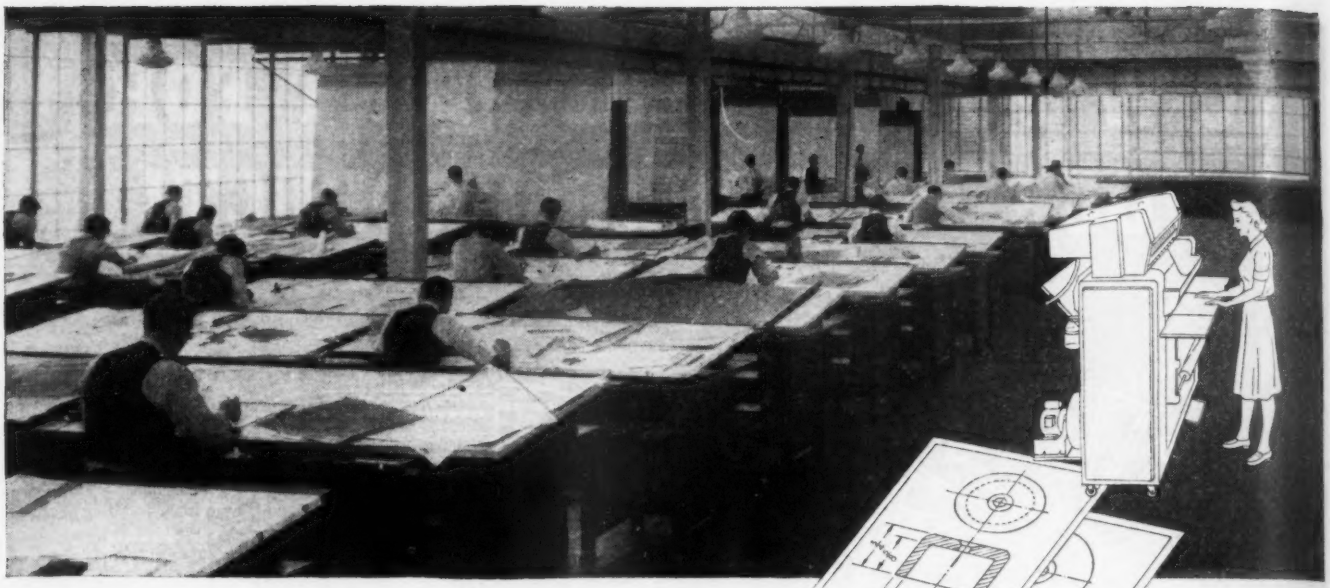

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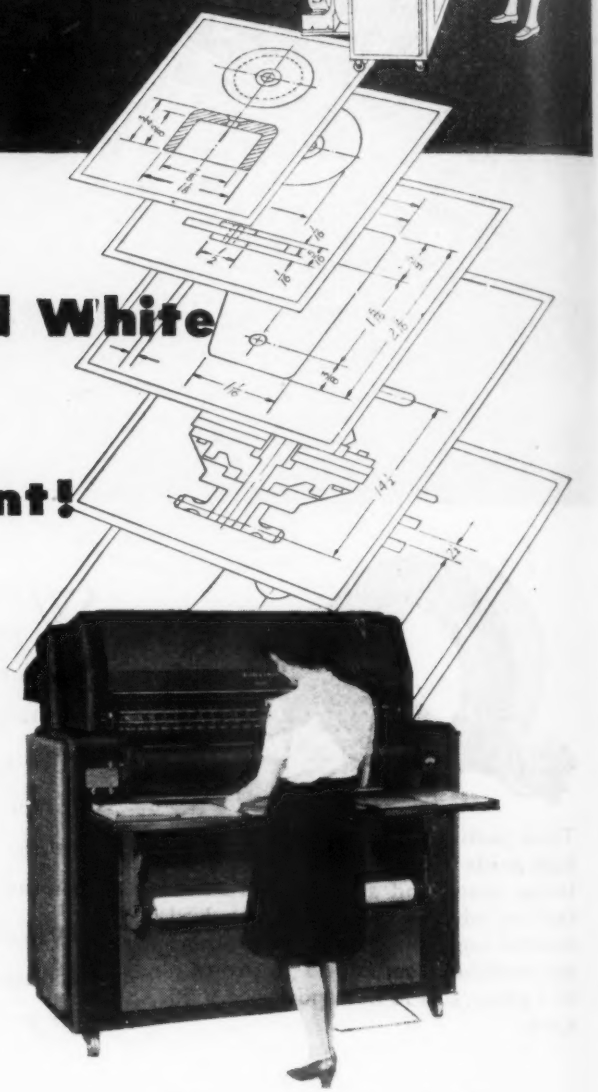

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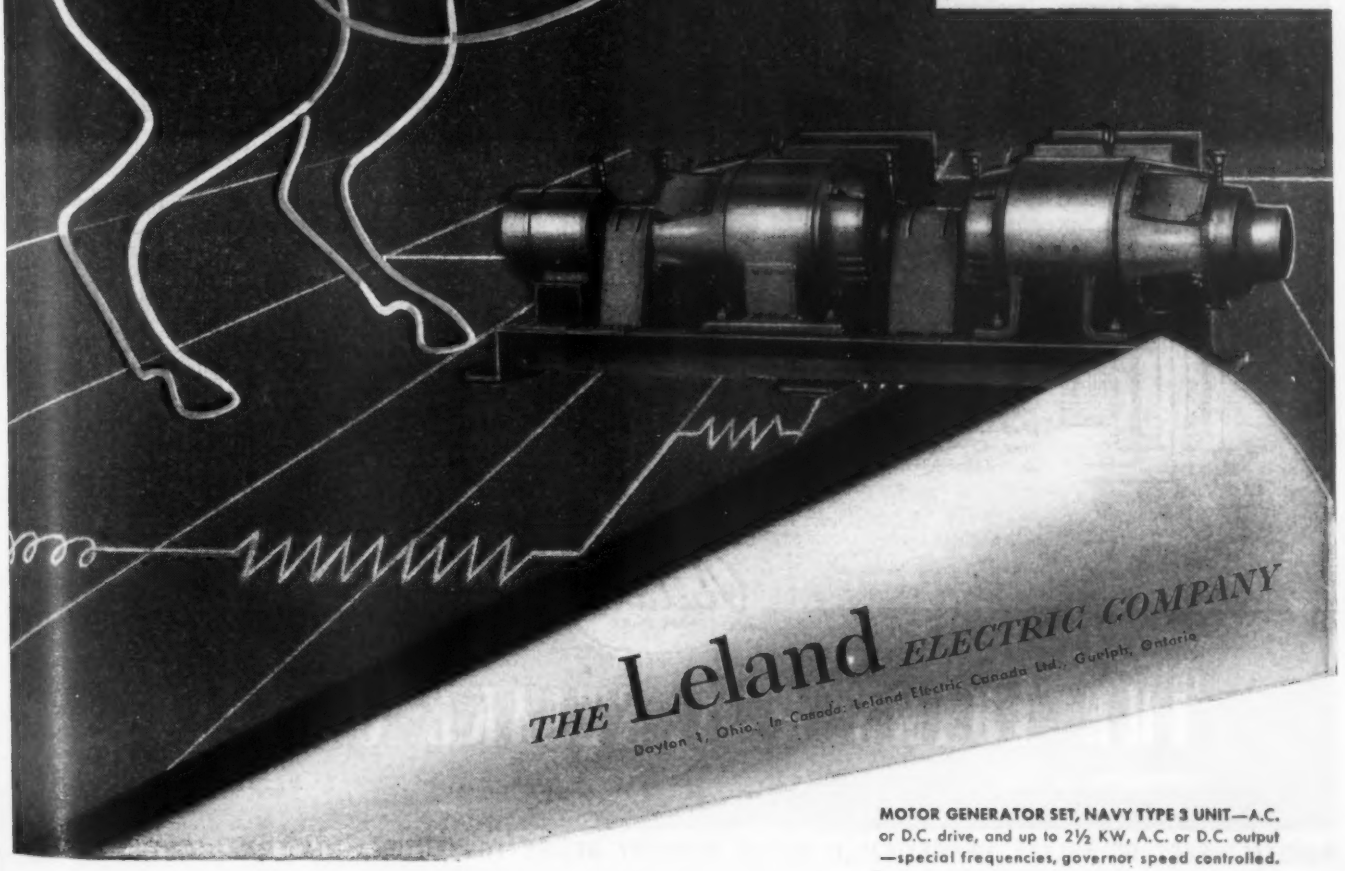
In this highly technical field, LELAND Electric has solved many difficult electrical problems with skill and ingenuity. This valuable experience may be the key to your post-war plan. We invite your inquiry.



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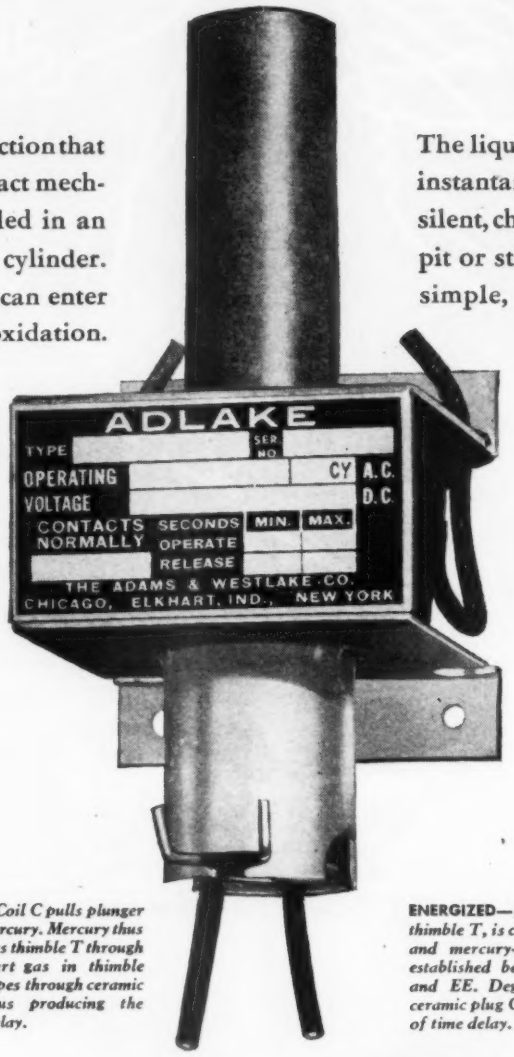
You can depend on silent Adlake plunger-type Relays to "make good" on every kind of equipment into which you design these modern, hermetically sealed mercury relays for timing, load and control circuits. May we co-operate with your designers by suggesting the type of Adlake Relays best adapted to your product?

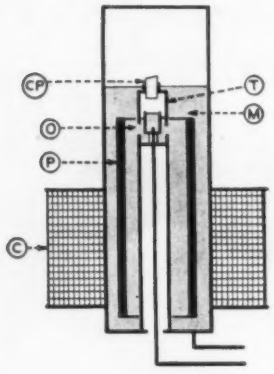
Adlake Relays have snap action that stays "snappy." The contact mechanism is hermetically sealed in an armored glass or metal cylinder. No dirt, dust, or moisture can enter . . . there is no danger of oxidation.

The liquid metal mercury contact is instantaneous, positive in action, silent, chatter-free, and cannot burn, pit or stick. No other relays are as simple, rugged and dependable. Write for bulletin.

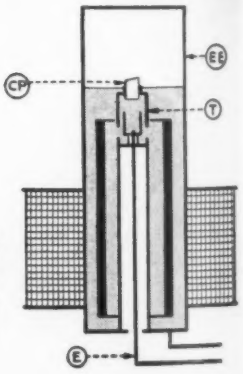


Adlake Model 1040 . . . for panel mounting . . . available with either quick or time delay action, normally open or closed.

Quick acting relays are available with contact ratings up to 50 amperes A.C. with proportional D.C. ratings.



ENERGIZED—*Coil C pulls plunger P down into mercury. Mercury thus displaced enters thimble T through orifice O. Inert gas in thimble gradually escapes through ceramic plug CP—thus producing the desired time delay.*



ENERGIZED—*Mercury now fills thimble T, is completely leveled off and mercury-to-mercury contact established between electrodes E and EE. Degree of porosity of ceramic plug CP determines length of time delay.*

Adlake TRADE MARK

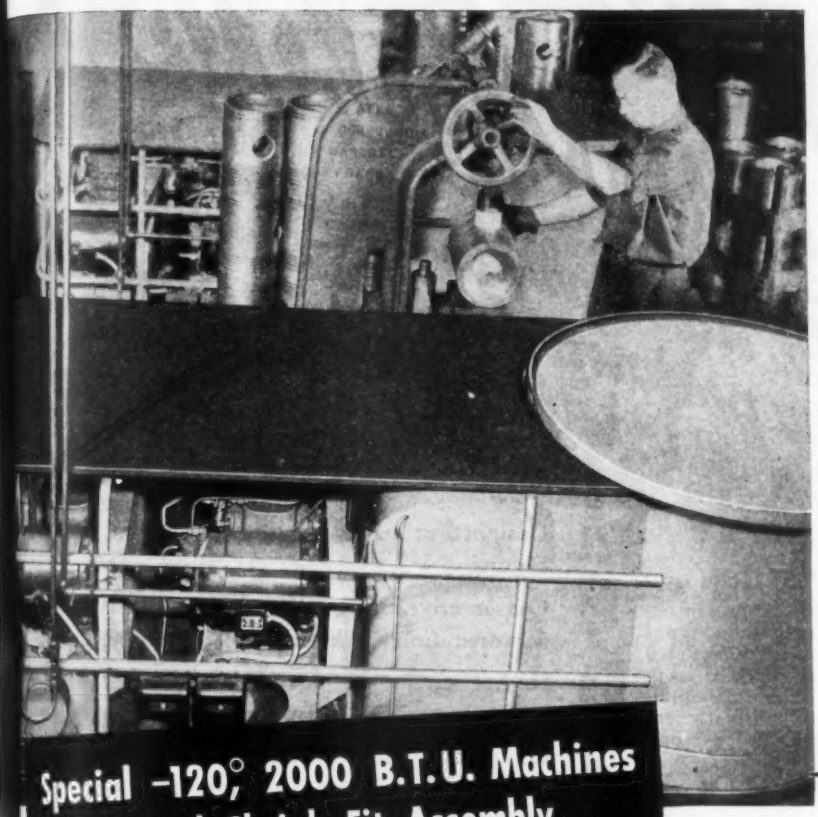
ARMY E NAVY

THE ADAMS & WESTLAKE COMPANY

ESTABLISHED IN 1857 — ELKHART, INDIANA — NEW YORK · CHICAGO

MANUFACTURERS OF ADLAKE HERMETICALLY SEALED MERCURY RELAYS FOR TIMING, LOAD AND CONTROL CIRCUITS

250% Increase in Piston Production with Deepfreeze



Special –120°, 2000 B.T.U. Machines Speed Shrink-Fit Assembly

Industrial Chilling Machines

After trying three methods of inserting bronze wrist pin bushings in cast-iron and aluminum Diesel pistons, this manufacturer solved his problem with two special Deepfreeze Industrial Chilling Machines. The first method was to anchor bushings in pistons with locking screws. Next, shrink-fit was tried using dry ice, but this proved unsatisfactory because only .002″ shrink was obtained. The third method, using liquid air, was also unsatisfactory because production was slow and cost high. Now, after installing two Deepfreeze machines, each capable of removing 2,000 B.T.U.'s per hour, production has increased 250% and cost has been reduced considerably.

Here's How It Was Done with Deepfreeze

The bronze bushings, .005″ over size, are immersed for three hours at −120° F. in the Deepfreeze machines. The bushings are shrunk so that only slight pressure with an arbor press is required for insertion in the piston. A special cradle fixture with a vertical pin serves the dual purpose of lining up the piston pin bore with the spindle of the arbor press and also as a stop for the bushing to locate it in the piston.

Deepfreeze Saves Labor and Production Costs

The best possible former production was 200 bushings assembled in 20 hours. Now, by the use of two Deepfreeze Industrial Chilling Machines 700 bushings are assembled in 20 hours. In addition, one operator turns out the work formerly requiring two. The cost of liquid air formerly used was $1.00 per litre with 30 litres used per day. With Deepfreeze machines there is only the relatively small cost of power required to operate four 1-hp. motors intermittently.

Learn How Cold Treating Can Save You Money

To determine the exact benefits that your company can derive from applying cold treating to your production, consult the Deepfreeze Engineering Service, which is conducted expressly for this purpose. Your inquiry will not obligate you in any way.

FREE...NEW COLD TREATING TEXTBOOK

A new 40-page booklet containing complete up-to-date information on cold treating, including new procedures, applications, performance data stories, etc., has just been published and will be sent to you upon request. Write for Bulletin No. I-4.

Only Motor Products can make a "DEEPFREEZE"

Deepfreeze

TRADE MARK DEEPFREEZE REGISTERED UNITED STATES PATENT OFFICE

Industrial Chilling Equipment for Shrinking, Testing, Hardening and Stabilizing Metals

2326 DAVIS STREET, NORTH CHICAGO, ILLINOIS

DIVISION OF
MOTOR PRODUCTS CORPORATION
DETROIT, MICHIGAN

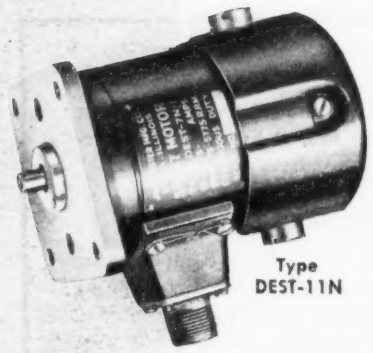
3 Oster Motors

that have proved their ability to perform dependably in aircraft applications

Type DEST-10N

Type DEST-10N

Totally enclosed. Approximately 9/16" shorter than types DEST-11N and DEST-12N. Rated at approximately 50% of tabulated values. Suitable for applications requiring a totally enclosed motor where space is limited.



Type DEST-11N

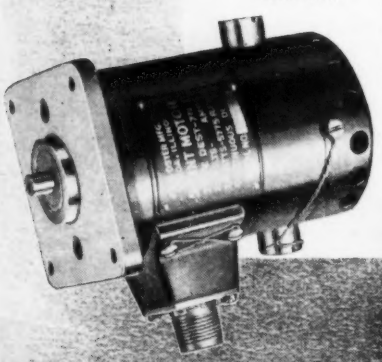
Type DEST-11N

Totally enclosed, fan cooled, air over motor. A motor that delivers maximum output where application demands a totally enclosed motor.

Type DEST-12N

Open construction, fan cooled, air through motor. This motor delivers maximum H.P. under the most extreme operating conditions. Being of open construction, it can be used only where the air contains no injurious elements which would damage the motor windings.

Type DEST-12N



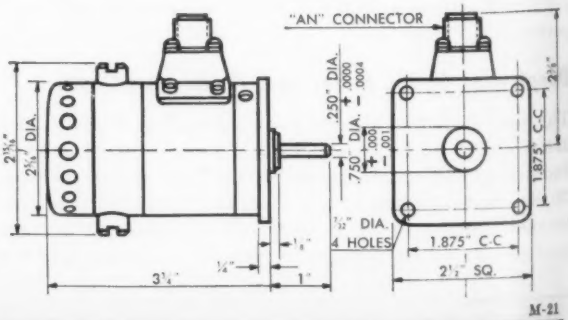
WINDINGS

Available with shunt, series, or split series windings for operation on 12 to 24 volts D.C., intermittent or continuous duty.

Let us help you fit these or other Oster motors to your requirements.

1. Designed primarily for low voltage D.C. applications.
2. Conservative rating makes these motors suitable for operation in high ambient temperatures.
3. Higher starting torque results in excellent starting characteristics in low ambient temperatures.
4. Compact, rugged construction as well as light weight makes these power units worthy of consideration when selecting motors for numerous aircraft applications.

Typical ratings of types DEST-11N and 12N, Series Wound			
R.P.M.	7500	5800	3800
Max. H.P.	1/20	1/25	1/40
F.L. Amps at 24 volts	2.4	2.1	1.5
Starting torque in % of F.L. torque	600 to 800	400 to 600	300 to 500



M-21

All ratings and data are approximate.

Oster FRACTIONAL H.P. ELECTRIC MOTORS

John Oster Manufacturing Co.

Department D-21 • Racine, Wisconsin

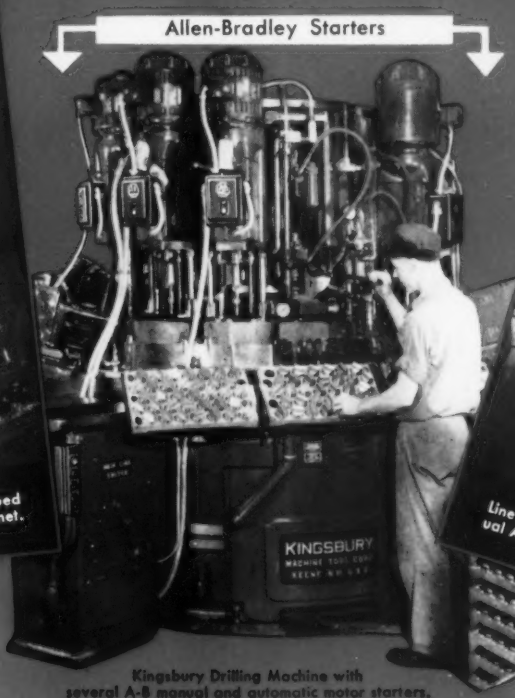
ALLEN-BRADLEY

MOTOR CONTROLS FOR PRODUCTION LINES

QUALITY

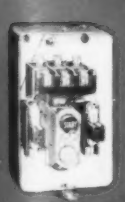
Turntable Unit with 18 centrifugal spinners each with an A-B Bulletin 712 Combination Starter.

Fin Milling Cutters in large automotive plant equipped with A-B control panels mounted in steel safety cabinet.

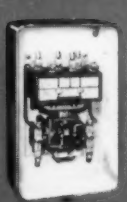


Kingsbury Drilling Machine with several A-B manual and automatic motor starters.

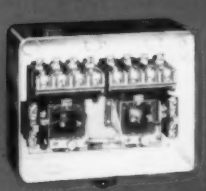
Line-up of Lincoln Welders each equipped with individual A-B Bulletin 609 manual across-the-line starter.



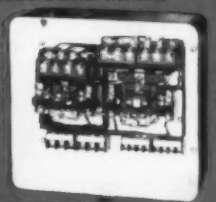
Manual Starter



Automatic Starter

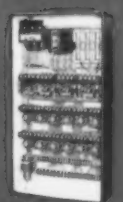


Reversing Switch



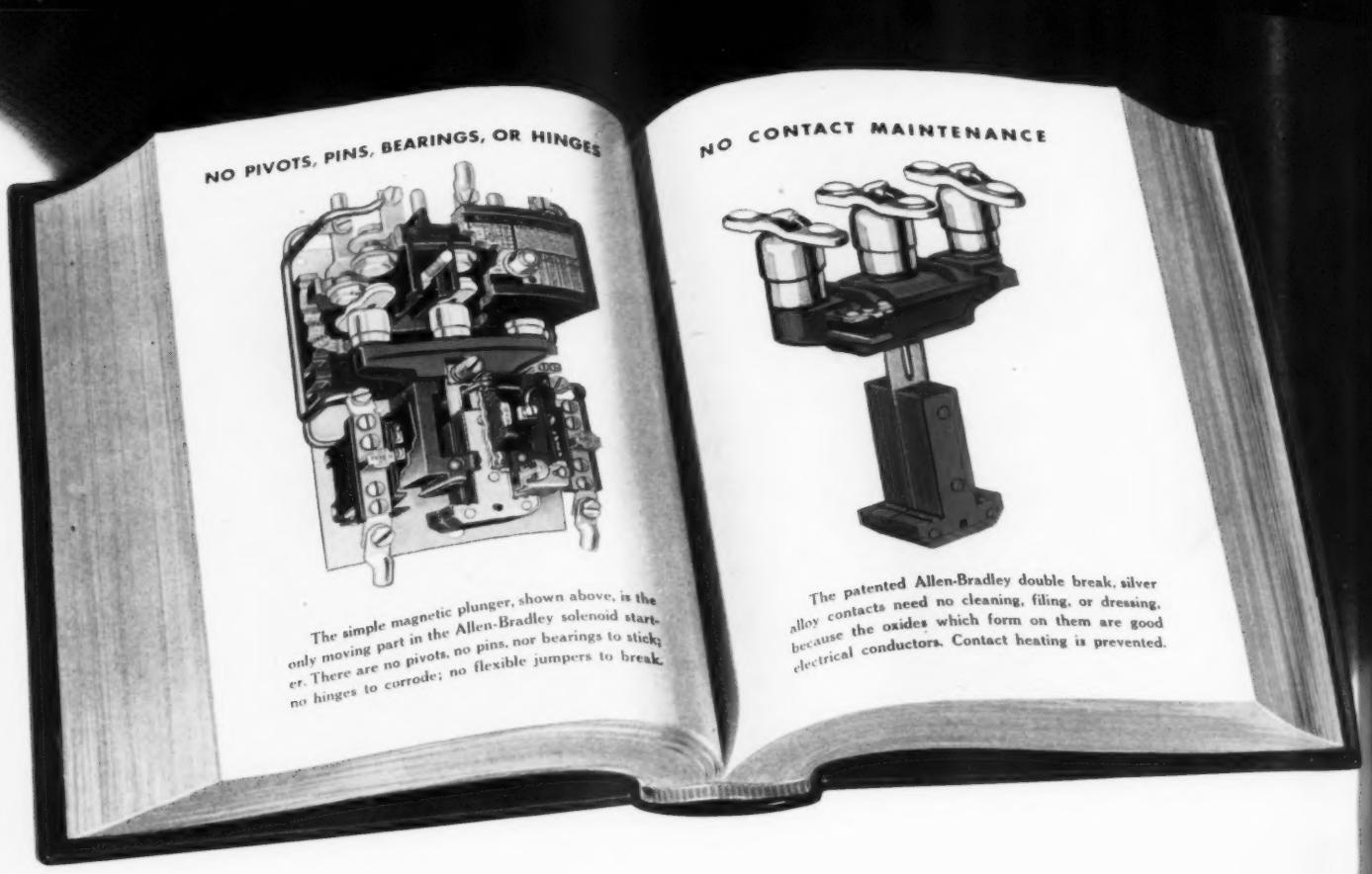
Multispeed Starter

Combination Starter



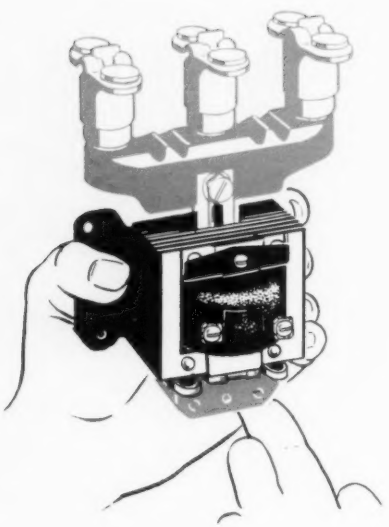
Machine Tool Control Panel

THERE IS AN ALLEN-BRADLEY STARTER TO FIT EVERY INDUSTRIAL APPLICATION


NO PIVOTS, PINS, BEARINGS, OR HINGES
The simple magnetic plunger, shown above, is the only moving part in the Allen-Bradley solenoid starter. There are no pivots, no pins, nor bearings to stick; no hinges to corrode; no flexible jumpers to break.
NO CONTACT MAINTENANCE
The patented Allen-Bradley double break, silver alloy contacts need no cleaning, filing, or dressing, because the oxides which form on them are good electrical conductors. Contact heating is prevented.

The Amazing Success Story of Allen-Bradley Solenoid Starters can be told in 4 words:

"Only one moving part"



The double break, movable contacts of the A-B solenoid starter are mounted on an insulated cross-bar which is attached to the simple magnetic plunger.

Every engineer knows... and every maintenance man agrees... that the greatest simplicity in design is the best assurance of trouble-free starter operation. Less parts mean less trouble.

Therefore, when a motor starting switch... like the Allen-Bradley solenoid starter... has *only one moving part*, it is not only the SIMPLEST but also the most trouble-free starter on the market.

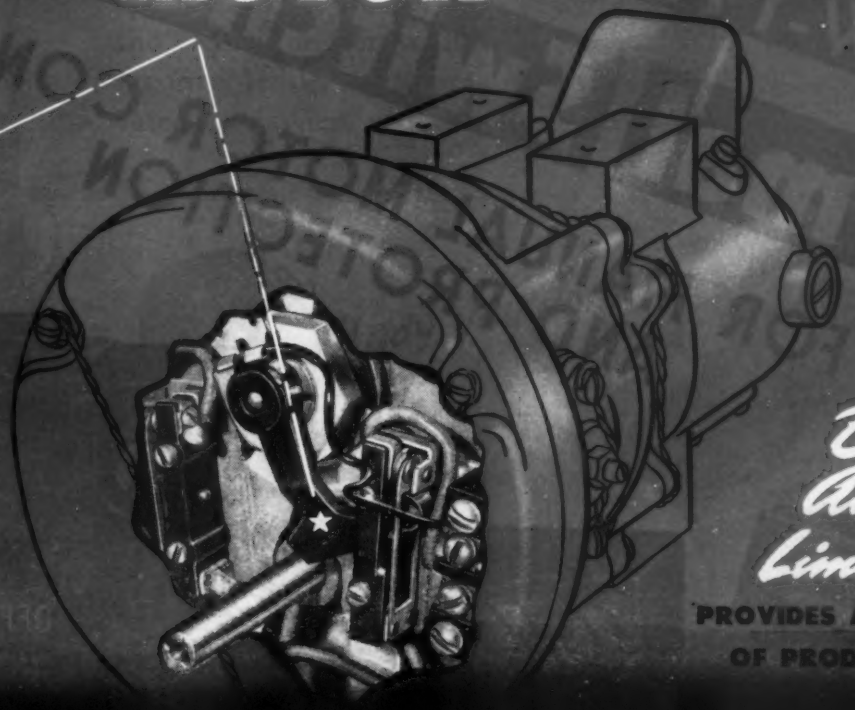
The widespread preference of machinery builders for Allen-Bradley solenoid controls accounts for the dominant position of the Allen-Bradley line in recent market surveys. Machinery builders understand the value of a simple design, especially in severe service... so they specify Allen-Bradley solenoid control.

Allen-Bradley Company, 1316 S. Second St., Milwaukee 4, Wis.

A-B

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY

THIS MOTOR STOPS ITSELF!



Built-in Automatic Limit Switch

PROVIDES ACCURATE CONTROL OF PRODUCT OPERATIONS

OTHER DUMORE FEATURES

GEAR REDUCTION UNITS

MAGNETIC BRAKES

MAGNETIC CLUTCHES

OVER-RUNNING CLUTCHES

THERMAL OVERLOAD PROTECTORS

POSITION INDICATING POTENTI-OMETERS

DUMORE WILL HELP YOU ENGINEER THIS COMPACT POWER AND CONTROL UNIT INTO YOUR PRODUCT!

If your product requires — or could be made more useful or salable by — a motor which can stop itself after a certain number of revolutions, you should get in touch with Dumore engineers at once. Because Dumore has developed and produced in large volume many of the ingenious fractional h. p. motors which have contributed so greatly to the fighting power of Allied aircraft, you can expect an unusual and practical solution to your motor-design problems. Come to "Headquarters" — give your product the benefit of the most advanced thinking in motor-design and motor-production! The Dumore Company, Motor Division, Racine, Wisconsin.

IT DOES MORE BECAUSE IT'S A

DUMORE

Motor-Plan Now!

FREE! Get this helpful design data book with complete specifications on Dumore Motors. Write for your copy today!

HEADQUARTERS FOR FRACTIONAL HORSEPOWER MOTORS

DEPENDABLE

ARROW-H&H Thermal Switches

FOR MANUAL MOTOR CONTROL AND PROTECTION

LOAD-LIMIT

"LOAD LIMIT"

Across-the-line type

START HERE for dependable operation of your machines *and* trustworthy protection of motors! This compact design packs all the safeguards that hard-driven power units *need now*. Thermal overload protection for polyphase motors up to 2 H. P., 440 V., A. C., or 1½ H. P., 230 V., D. C. For single phase to 1½ H. P., same voltages. Interchangeable heaters from 0.24 Amps. to 12.5 Amps. provide 28 different ratings without special fusing. . . Silver-plated switch contacts with knife action. Full floating, self-aligning *movable* contacts, spring-reinforced. Thermal protection by bi-metallic action. Trip-free mechanism; smooth, positive action; Bakelite base. Ask for Catalog 9-M, with engineering recommendations for your *special* control problems.

Size "0"

A. C. Horsepower Ratings

Volts:	110	220	440
Single phase:	1	1½	1½
Polyphase:	1½	2	2

D. C. Horsepower Ratings

Volts:	115	230
Single Pole:	½	¾
Double Pole:	1	1½

★ 28 different ratings of interchangeable heaters. ★

INDUSTRIAL CONTROL DIVISION

ARROW-HART & HEGEMAN ELECTRIC CO., HARTFORD, CONN.

heart trouble – (in appliances) Any failure of the electric motor which inconveniences and aggravates the owner.

"Lady, you don't have to do that!"

There's no "heart trouble" in that appliance—*it has an* EMERSON-ELECTRIC MOTOR

Of course, no woman is going to take along a stethoscope when she buys a motor-driven electric appliance. But this much is true—what the *heart* is to the human body, the *motor* is to the appliance. It's just smart buying and good common sense to make sure you get a strong, reliable motor—a motor that is precision-built to give QUIET, uninterrupted operation.

If the motor in your appliance is an Emerson-Electric, you can be *sure* it *will* give you long, faithful service. Because Emerson-Electric Motors are made by the same people who make the famous Emerson-Electric Fans—many of which have been in operation 25 years and longer!

So, when you buy these new home appliances, ask "Do they have Emerson-Electric Motors?"

Are you going to modernize or build a new home? Write today for complete information on Emerson-Electric Kitchen Ventilating Fans and Home Cooler Fans.

THE EMERSON ELECTRIC MANUFACTURING CO.
ST. LOUIS 3, MISSOURI
Branches: New York • Chicago • Detroit • Los Angeles • Davenport

The American Way of Life is Powered with Electric Motors

For more than 54 years Emerson-Electric Motors have been providing dependable power for many of America's best-known appliances, and helped to build the reputation of their makers.

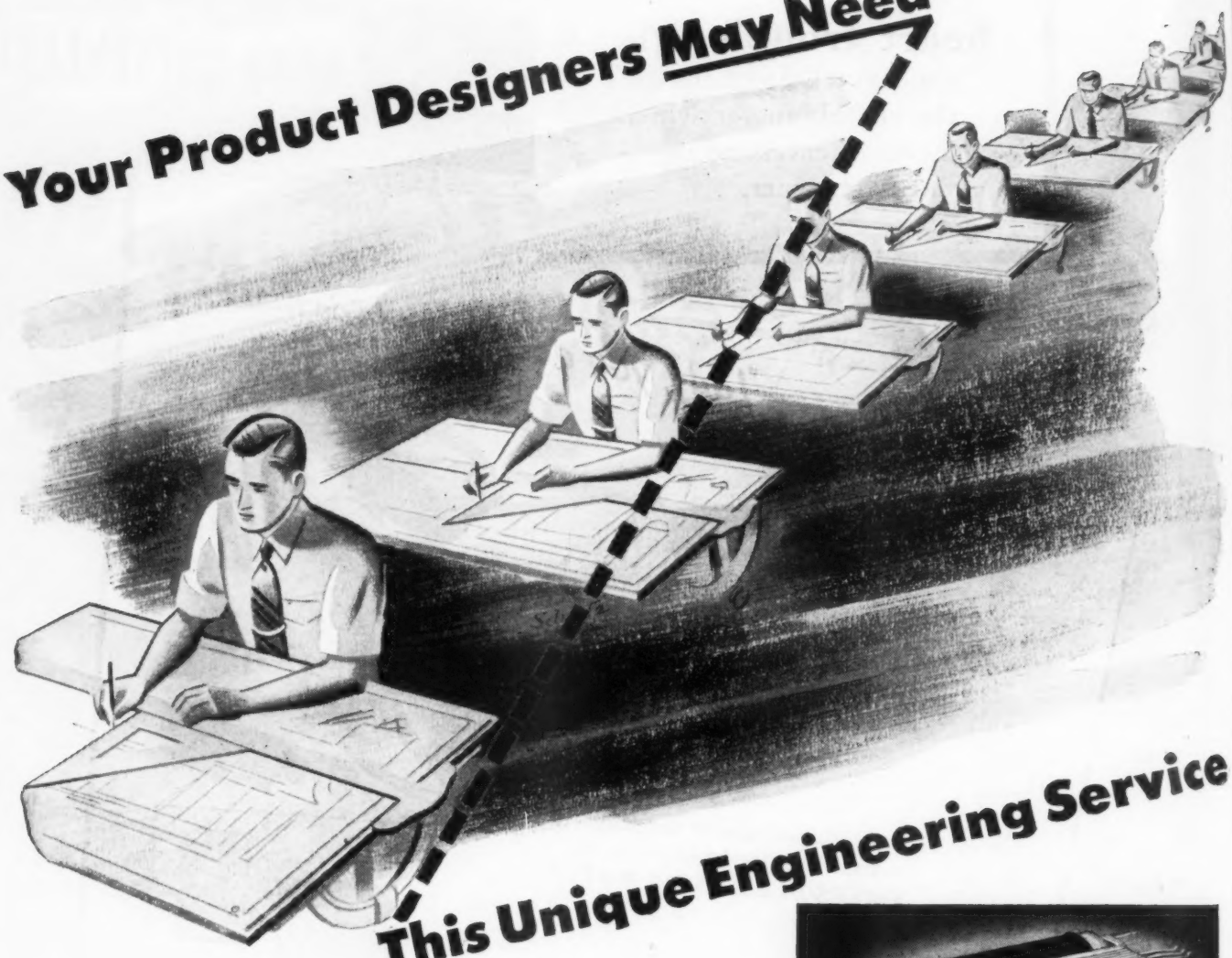
EMERSON ELECTRIC MOTORS · FANS
EMERSON ELECTRIC APPLIANCES

One of a series of advertisements appearing in National Magazines

If your future plans include the manufacture of motor-driven appliances it will pay you to investigate Emerson-Electric Motors—made to give long, faithful service without "heart trouble."

419

Your Product Designers May Need



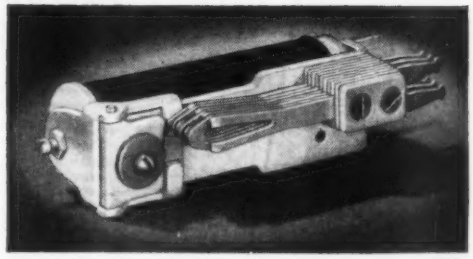
This Unique Engineering Service

There are hundreds of products on drawing boards today that will do a better job at lower cost with the *right* electrical control apparatus. The problem is: precisely what apparatus?

That is where the Automatic Electric field engineer can help. He is a specialist in electrical control, backed by an organization that offers this three-point service:

1. Technical advice by experienced field engineers, who know the "how" and "why" of control technique.
2. A complete range of relays, stepping switches and other control units—time-proved products readily adapted to your needs.
3. A design and manufacturing service for complete engineered assemblies.

Ask our field engineer for a copy of our catalog of control devices. He will be glad to show you how they can serve you.



Here are jobs that can be done easier and better with Automatic Electric control devices:

Automatic Selection and Switching of Circuits • Time, Temperature and Sequence Control • Counting and Totalizing • Inspection and Sorting Operations • All Types of Electrical and Electronic Control.

Relays
AND OTHER CONTROL DEVICES
by **AUTOMATIC ELECTRIC**

AUTOMATIC ELECTRIC SALES CORPORATION
1033 West Van Buren Street • Chicago 7, Illinois

In Canada: Automatic Electric (Canada) Limited, Toronto

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

NO. 1 IN A SERIES EXPLAINING HOW ELECTRONIC TUBES CAN BE USED TO IMPROVE EQUIPMENT DESIGN

Current rectification and motor control by the THYRATRON

Two of the chief applications of electronic tubes in equipment design may be named as (1) to rectify electrical current without the use of rotating equipment, (2) to provide automatic regulation of speeds, temperature, etc. In the thyratron —most versatile of tubes—these functions are efficiently combined.

Thyratron equipment is employed to operate small d-c motors from an a-c power source, and at the same time keep these motors running at the proper speed, regardless of varying loads. The thyratron is a gas-filled tube with one or more grids to control power with split-second precision. Pioneered by General Electric, it performs numerous valuable functions in industry with which design engineers may profitably acquaint themselves.

The many advantages of electronic-tube applications of various types justify a thoroughgoing study of such applications *in every case* where a design is on your boards for development. General Electric will be glad to cooperate in this study, by providing engineering advice on which you may safely base final construction plans. For general or specific information about G-E electronic tubes and their industrial applications, consult your nearest G-E office or distributor. Also ask for the illustrated book on "How Electronic Tubes Work." It is filled with facts about the way tubes operate, how they are classified by design and function, and the many difficult tasks you may turn over to them with confidence. *Electronics Department, General Electric, Schenectady 5, N. Y.*

TUNE IN General Electric's "The World Today" and hear the news from the men who see it happen, every evening except Sunday at 6:45 E.W.T. over CBS network. On Sunday evening listen to the G-E "All Girl Orchestra" at 10 E.W.T. over NBC.

THYRATRON GL-3C23
PRICE $9

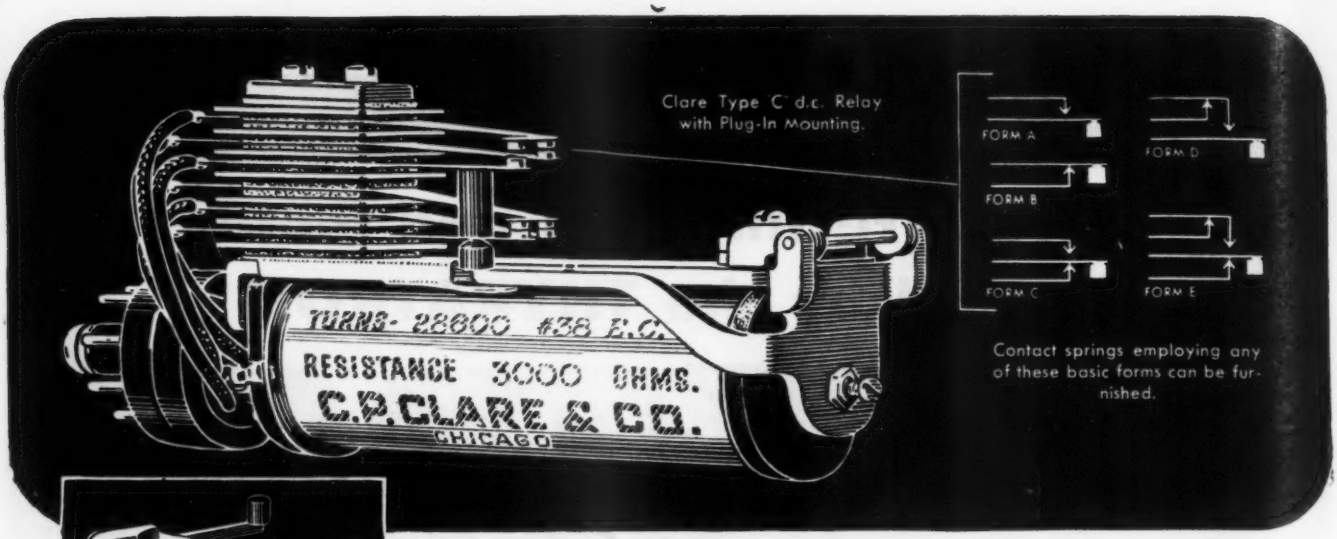
This widely used thyratron is a rectifier-regulator, 3-electrode tube of medium output—1,250 v (peak inverse) and 1.5 amp (average). The coated-filament cathode is a quick-heating type; only 15 seconds are required. Exemplifying an important industrial use of the thyratron group, type GL-3C23 is especially applicable to motor control circuits. Singly it can be used for motors of ⅓ to ½ hp, and in pairs for larger motors up to 3 hp where 3 amp is required.

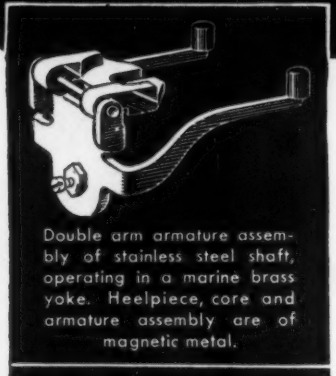
The gas mixture of argon and mercury vapor helps to provide constancy over an exceptionally wide temperature range —from −40 to +80 C—which is important where motors must be started in sub-zero weather or function at high temperature levels. Another feature is uniformity of electrical characteristics. This gives assurance of successful operation to the design engineer who includes the GL-3C23 in his circuits.

G. E. HAS MADE MORE BASIC ELECTRONIC-TUBE DEVELOPMENTS THAN ANY OTHER MANUFACTURER

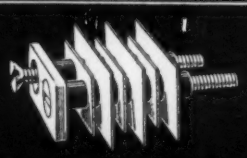
GENERAL ELECTRIC

162-D2-8850



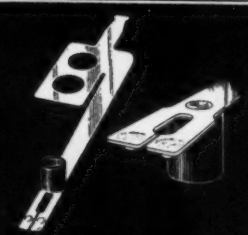


Double arm armature assembly of stainless steel shaft, operating in a marine brass yoke. Heelpiece, core and armature assembly are of magnetic metal.



High voltage spring pile-up insulators of special heat-treated Bakelite. Has minimum cold flow properties, low moisture absorption content and permits punching without cracks or checks.

Contacts are welded to nickel silver springs by special process. May be of precious metals or alloys in 12 different standard or special types and sizes.



Spring bushing insulators are made of Bakelite rod under patented process. Resist vibration and withstand heavy duty service.

CLARE "CUSTOM-BUILT" RELAYS

Can be depended on under most severe conditions of Temperature . . . Humidity . . . Atmospheric Pressure . . . Voltage . . . or Vibration

THE Clare Type "C" d.c. Relay, like all Clare "Custom-Built" Relays, has that unusual flexibility of design that permits the design engineer to have just the relay for the specific function required.

By "custom-building" the Clare Type "C" Relay in this way, Clare assures exceptional service in spots where hard usage, long life and absolute dependability are of prime consideration. Severe conditions of temperature, humidity, atmospheric pressure, voltage and vibration are met by including in the relay construction the particular Clare feature or features to meet them.

The Clare Type "C" Relay can be "custom-built" to work perfectly under conditions that call for definite times for operation and release of the relay, high speed keying without contact chatter, marginal operation which may include close pick-up and drop-out values, the transfer and switching of high frequency circuits . . . and many others.

Design engineers have found the innumerable contact arrangements possible with the Clare Type "C" to be valuable. Some of the important uses to which these relays have been put include:

- Sequence control of machine tools
- Radio, radar or other electronic controls
- Electric eye controls
- Counting equipment
- Alarm systems

Pictured and described here are some of the special Clare construction features that make it possible for Clare Relays to so effectively reduce overall relay cost, simplify installation and insure better and more dependable performance.

Clare engineers are ready at all times to assist in developing a relay "custom-built" to your exact requirements. Send for the Clare catalog and data book. C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago (30), Illinois. Sales engineers in all principal cities. Cable address: CLARELAY.

CLARE RELAYS

"Custom-Built" Multiple Contact Relays for Electrical, Electronic and Industrial Use

PRODUCTION "*Muscles*"...
FOR THE TASKS OF PEACE

WARTIME EXPERIENCES have developed production "muscles" for the communications industry that will be used to excellent advantage in the tasks of peace. With our customers, old and new, we have enjoyed a relationship that points clearly to the road to peacetime production. For instance:

1 **Our Old Customers Learned** that Sickles production facilities were flexible and versatile. Conversion from peacetime to wartime production was quick and effective. Quantity was stepped up rapidly. Quality was maintained.

2 **Our New Customers Learned** that it is practical to sub-contract parts and components to Sickles. To many of them, this was a new experience. We expect them to continue to profit from that experience in peacetime.

3 **Sickles Learned** that our foundation for such production was sound. In three years, we have gained additional experience that must be the equivalent to that of ten years. Reconversion to peacetime production will be smooth. Our facilities will help our customers to deliver the goods of peace as they did the weapons of war.

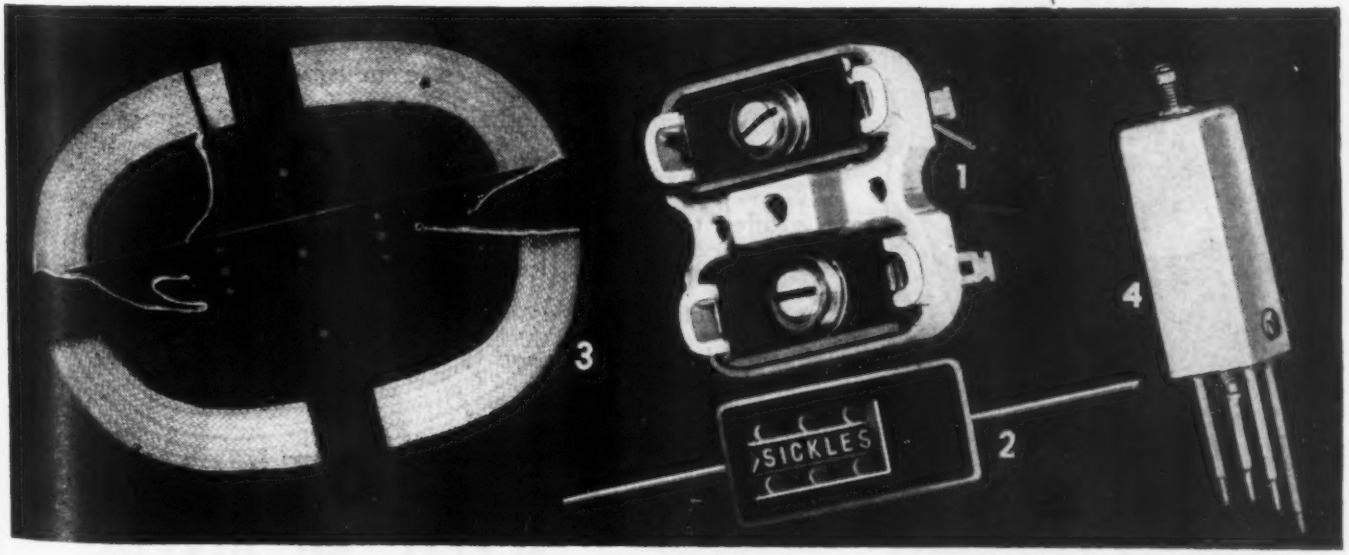
So our postwar plan is extremely simple. It is to continue to serve our customers in meeting their specialized needs for performance, quality, quantity and low cost. To us, that program seems sound. Can we help you now, to plan *your* postwar production "muscles"?

SOME SICKLES FIRSTS

1. 1933—Dual Mica Trimmers*
2. 1936—Silver Cap Condensers*
3. 1940—Low-loss "Ripple" Loops*
4. 1941—Midget I.F. Assemblies
5. 194V—More Coming

* *Patented*

THE F. W. SICKLES COMPANY • CHICOPEE, MASSACHUSETTS

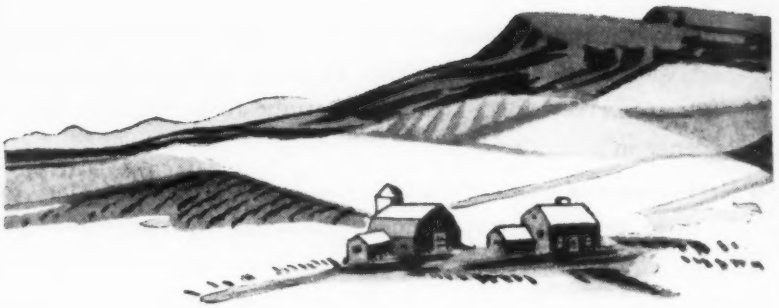


SICKLES

Radio and Electronic Specialties for Today and Tomorrow

...Hardly had man learned to fly than he began to feel the urgency of the need to communicate between ground and plane.

Radio headsets are one of C. T. & E. Division's contributions to aviation communications in World War II.



One of the first successful attempts in such two-way contact was accomplished with equipment designed and manufactured by *Connecticut Telephone & Electric.*

Since the early days of the telephone, our people have been identified with progress in communications. Today the principles of communications have applications of the greatest importance to industry, in connection with product development and production control.

Our developmental engineers also have much to offer to industrial executives seeking to produce a better product at lower cost. If our engineering and production facilities might tie in with your plans, we shall be happy indeed to talk with you.

ARMY NAVY

GAI

CONNECTICUT TELEPHONE & ELECTRIC DIVISION

GREAT AMERICAN INDUSTRIES, INC.

MERIDEN, CONNECTICUT

TELEPHONIC SYSTEMS • SIGNALLING EQUIPMENT • ELECTRONIC DEVICES • ELECTRICAL EQUIPMENT • HOSPITAL AND SCHOOL COMMUNICATIONS AND SIGNALLING SYSTEMS • IGNITION SYSTEMS

So we built more SNAP-LOCK TRADE MARK switches ...FOR TOUGH SERVICE

People often ask us, "Why should a machine-tool builder produce his own switches and solenoids?"

The answer is that the commercial grades, built for lighter service, got old too fast in the tough going on heavy duty machines where there just isn't any room for failure.

Other manufacturers wanted this same ability to "take it" in their electrical equipment. And now, for example, over 80% of the builders of automatic machine tools use Snap-Lock Limit Switches.

SNAP-LOCK SWITCHES

Separate enclosures for electrical and mechanical sides. Positive locking in on or off position —no stopping on center. Extra heavy construction and insulation. For any normal circuit—levers and mountings to suit.

Bulletin EM-42

SNAP-LOCK CONTROL STATION SWITCHES

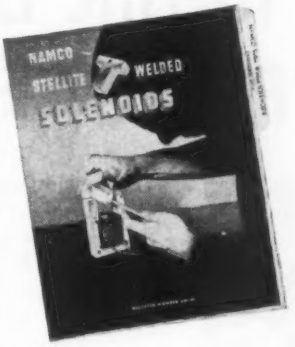
Standard assemblies have 3, 2 or 1 button combinations — flush, box or pendant mounting. Have all the stamina and dependability that come with the tried-and-proved Snap-Lock principle. Ask for recommendations based on your requirements.

Bulletin EM-43

SNAP-LOCK MOTOR STARTER SWITCHES

Built for 3-pole wiring, up to 2½ HP, AC or DC. Heavy silver contacts, all mechanical parts hardened steel, extra heavy insulation. Positive locking, in open or closed position, protected against arcing. Proved in battle service by U. S. Navy.

Bulletin EM-45



NAMCO SOLENOIDS

Built for heavy duty service. "Stellite"-weld inserts stop plunger "mushrooming", and insure long wear. Exceptionally rugged construction throughout. Capacities, 4 to 30 pounds push or pull, at 1" stroke. Do all kinds of jobs—automatically.

Bulletin EM-41

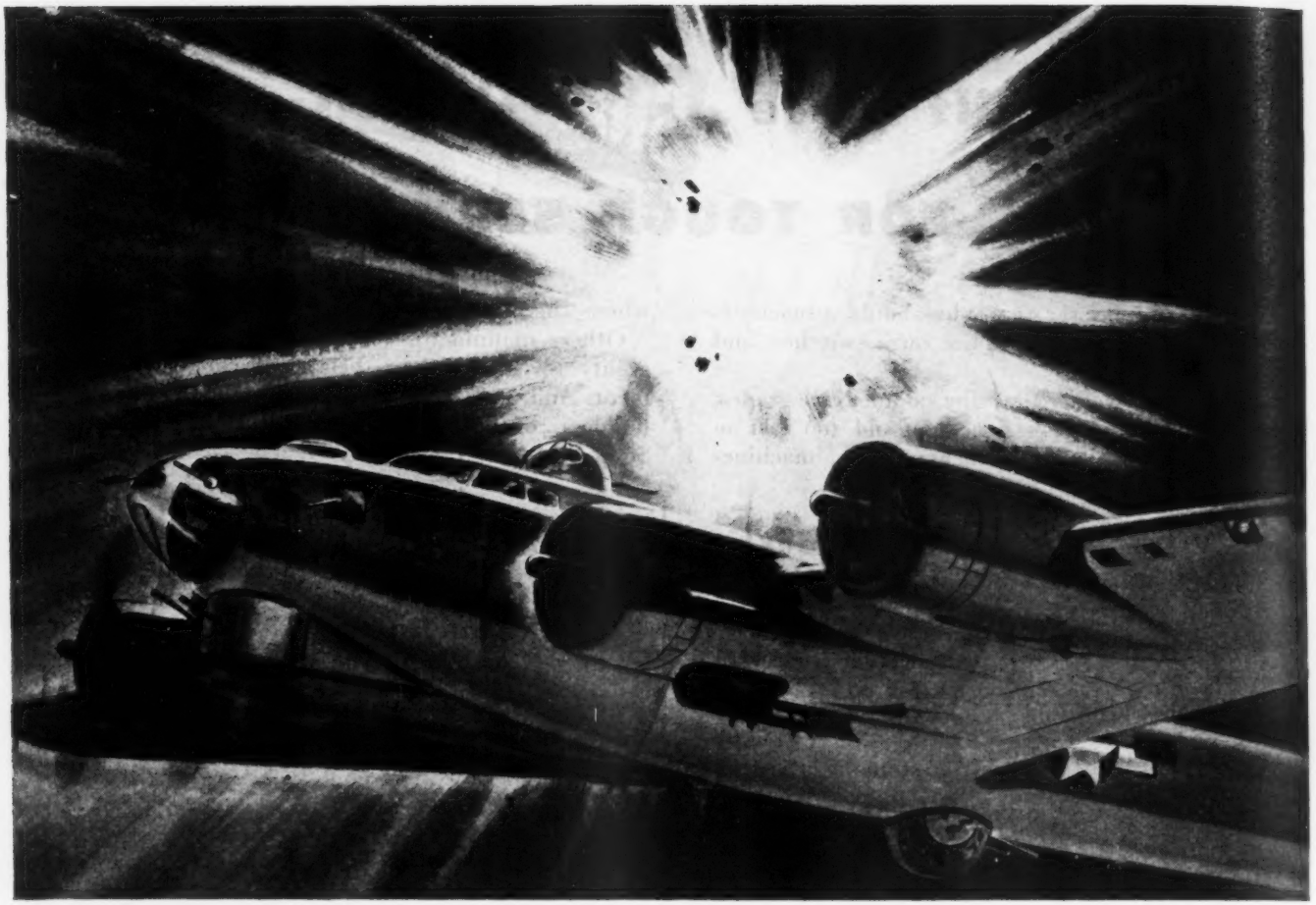
The National Acme Electrical Department will gladly help you *engineer* these rugged electrical devices to suit the requirements of your particular job.

ELECTRICAL MANUFACTURING DIVISION

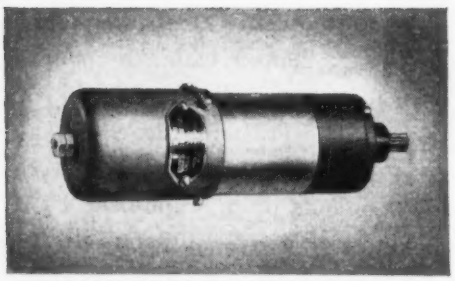
THE NATIONAL ACME CO.

170 EAST 131ST STREET • CLEVELAND 8, OHIO

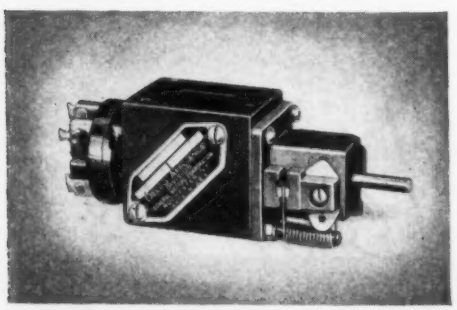
ACME-GRIDLEY 4-6 AND 8 SPINDLE BAR AND CHUCKING AUTOMATICS • SINGLE SPINDLE AUTOMATICS • AUTOMATIC THREADING DIES AND TAPS
THE CHRONOLOG • LIMIT, MOTOR STARTER AND CONTROL STATION SWITCHES • SOLENOIDS • CENTRIFUGES • CONTRACT MANUFACTURING



What a terrific beating millions of DELCO APPLIANCE Motors are taking!



FIRE CONTROL COMPUTER MOTOR. This special Delco Appliance Motor is equipped with a quick, positive, electric brake, compactly designed and specially efficient.



AERIAL CAMERA TIMER MOTOR. This Delco Appliance Motor incorporates a Delco-designed positive action governor directly connected to the armature shaft, which holds speed within very close limits.

On battle fronts all over the world —millions of Delco Appliance electric motors prove their ability to take a beating and keep on running! Heat, cold and concussion from exploding flak cannot keep these remarkable little motors—some of them weighing but a few ounces—from carrying on the work for which they were built—operating bombsights, aerial cameras, gun charger timers, indicating instruments, gyro stabilizers, gun sight computers and doing a multitude of other highly necessary war jobs.

Such dependability reflects in a high degree, intensive research, expert engineering, advanced design, thorough testing, expert workmanship and quality-controlled production.

After the war, you will want small electric motors such as these to power your peace-time products. Choose Delco Appliance motors and you will be choosing motors with a background of brilliant performance and proven stamina. DELCO APPLIANCE DIVISION, General Motors Corp., Rochester, N.Y.

GENERAL MOTORS

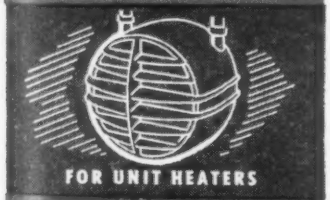
DELCO APPLIANCE

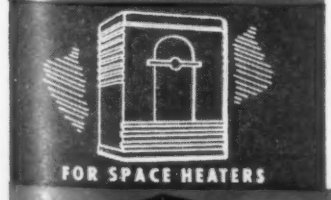
Fractional Horsepower Motors

Versatile

Redmond MICROMOTORS

FOR HEATING, VENTILATING AND AIR-CONDITIONING





HERE'S important news for postwar planners. Right now Redmond is ready with new shaded pole AC Micromotors, for a twenty-fifth horsepower or less on continuous duty.

They're compact, quiet and unique in construction. They're inexpensive, long lasting and good looking. And when it comes to versatility they're adaptable to countless applications.

You should get thoroughly acquainted with the new shaded pole Micromotors. Write us today and get the whole story.

A. G. Redmond Company

OWOSSO, MICHIGAN, U. S. A.

REDMOND KNOWS MOTORS

R REDMOND

Composite view of Redmond facilities with over 5 acres of floor area
AC AND DC MICROMOTORS
DYNAMOTORS
SPEED CONTROLLERS
BLOWERS

Power Your Postwar Products with DELCO MOTORS

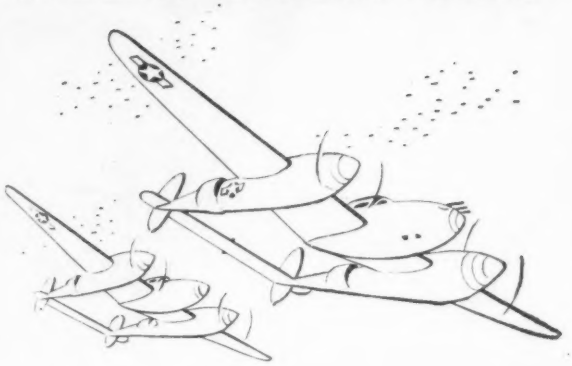
WHATEVER your product and whatever its power requirements, it will benefit by the *long life and dependability* that are built into Delco motors. These qualifications—known to millions of appliance users and appreciated by thousands of appliance dealers—are based on Delco Products' long experience in manufacturing electric motors to meet specific requirements.

DELCO KNOW-HOW

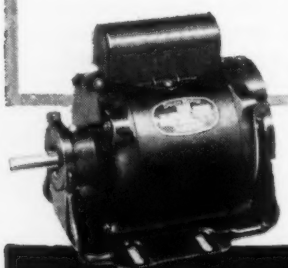
Delco Products has worked closely with leading manufacturers of refrigerators, washers, ironers, oil burners, stokers, air conditioners and other motor-driven products, to achieve the most satisfactory motor for each type of application.

This know-how, backed by the research and manufacturing facilities developed through years of service, is ready to be applied to your specific problems.

DELCO SHOW-HOW



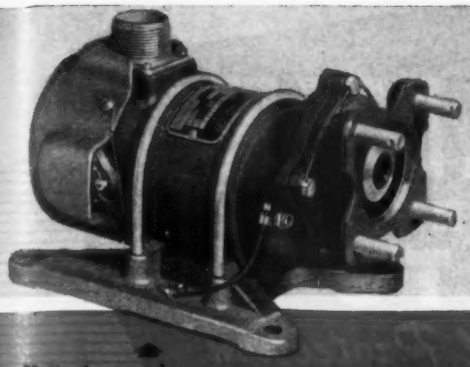
During the war, Delco Products has built thousands of precision electric motors to meet the needs of the aircraft industry . . . fuel pump motors, machine gun mount motors, windshield wiper motors, defroster fan motors and motors for precision instruments. The technological progress and intensive research involved in this assignment—together with improved manufacturing methods and increased facilities—promise continued leadership for Delco Products in the development of better motors for all types of products.



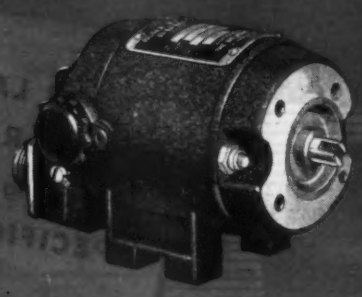
Shorten the War—with MORE WAR BONDS

DELCO MOTORS

DIVISION OF GENERAL DELCO PRODUCTS DAYTON, OHIO MOTORS CORPORATION



Does that *New* PRODUCT require a fractional horsepower Special Application MOTOR?



Helical geared aircraft fuel transfer pump motor . . . adaptable to many industrial uses.

For light power uses where accuracy and reliability are extremely important.

Completely enclosed motor for portable devices requiring dependable power.

Designed for aircraft heater . . . readily adapted to mixers, fan drives, grinding operations, etc.

For such industrial applications as high-speed grinders, routers, and small sanders.

3 REASONS why it should be considered in the EARLY STAGES of Product Development

1. To allow ample time for thorough study of the application from the standpoint of torque requirements, weight, and space factors.

2. To enable the motor builder to use his full resources of skill, experience and ingenuity in designing a motor that will insure the best *motor* performance.

3. To make full use of the motor builder's product experience out of which frequently comes suggestions that result in improved *product* operation.

Our new 42-page catalog, containing specifications, dimensions, and other useful data, will help your engineering department derive the full benefits of considering the motor in the *early* stages of product development.

THE LAMB ELECTRIC COMPANY
Kent, Ohio

Lamb Electric

FORMERLY Black & Decker Electric

SPECIAL APPLICATION FRACTIONAL HORSEPOWER **MOTORS**

NEW OHMITE ARMY-NAVY AIRCRAFT RHEOSTATS

with New Improved Control Protection

FOR LATEST AN-R-14a (Drawing AN3155) SPECIFICATIONS

Smooth, Close, Dependable Control Under Every Service Condition of

HEAT COLD HUMIDITY ALTITUDE SHOCK VIBRATION

These new Ohmite AN Rheostats are light in weight—much lighter than the allowable weight specified. Meet salt spray corrosion test. Operate satisfactorily in the temperature range from −55°C (−67°F) to +70°C (+158°F).

Here are the new approved Ohmite Power Rheostats for aircraft, made in accordance with the latest Army-Navy Aeronautical Specifications. These units have the advantage of many time-proved Ohmite rheostat features *plus* new, improved control protection. They are rugged in design and construction to provide uniform electrical and mechanical control . . . and assure utmost dependability . . . under all operating conditions.

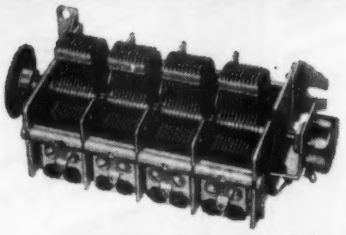
Two sizes: Model "J" 50-watt and Model "H" 25-watt. Linear or Taper wire-wound, in various resistances, with "off" position, as required. Totally enclosed in a compact, corrosion-resisting metal container. Complete with knob as shown. Write, wire or phone for further information.

OHMITE MANUFACTURING CO.
4819 FLOURNOY ST., CHICAGO 44, U. S. A.

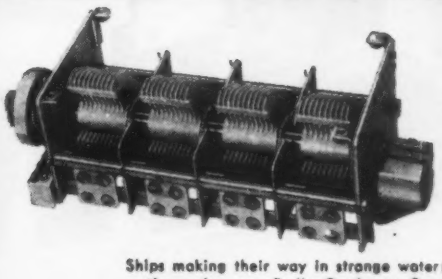
Be Right with **OHMITE**

RHEOSTATS • RESISTORS • TAP SWITCHES

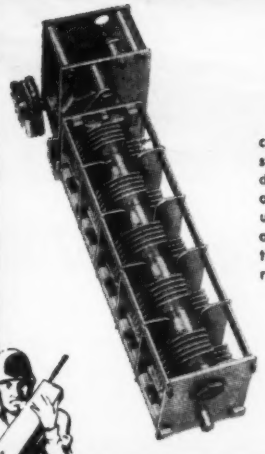
. . . THAT VITAL MESSAGES OF OUR FIGHTING FORCES WILL BE RECEIVED —*Distinctly!*



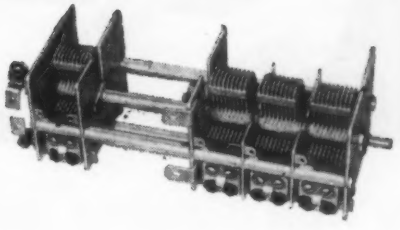
America's planes, once they're pointed toward the enemy, must receive every radio communication message *distinctly!* Accurate radio tuning is assured with Radio Condenser Company's variable air condensers.



Ships making their way in strange waters — they, also, use Radio Condenser Company's variable air condensers, so that there is accurate tuning to receive each message.



Even small radio communication sets, strapped to our soldiers as a vital part of their equipment, use these variable air condensers. Distinct tuning is the reward.



Of no less importance are the radio communication sets in our big, powerful tanks. They, too, play an important part, and even when the going is rough-and-tumble, these air condensers provide accurate radio tuning.

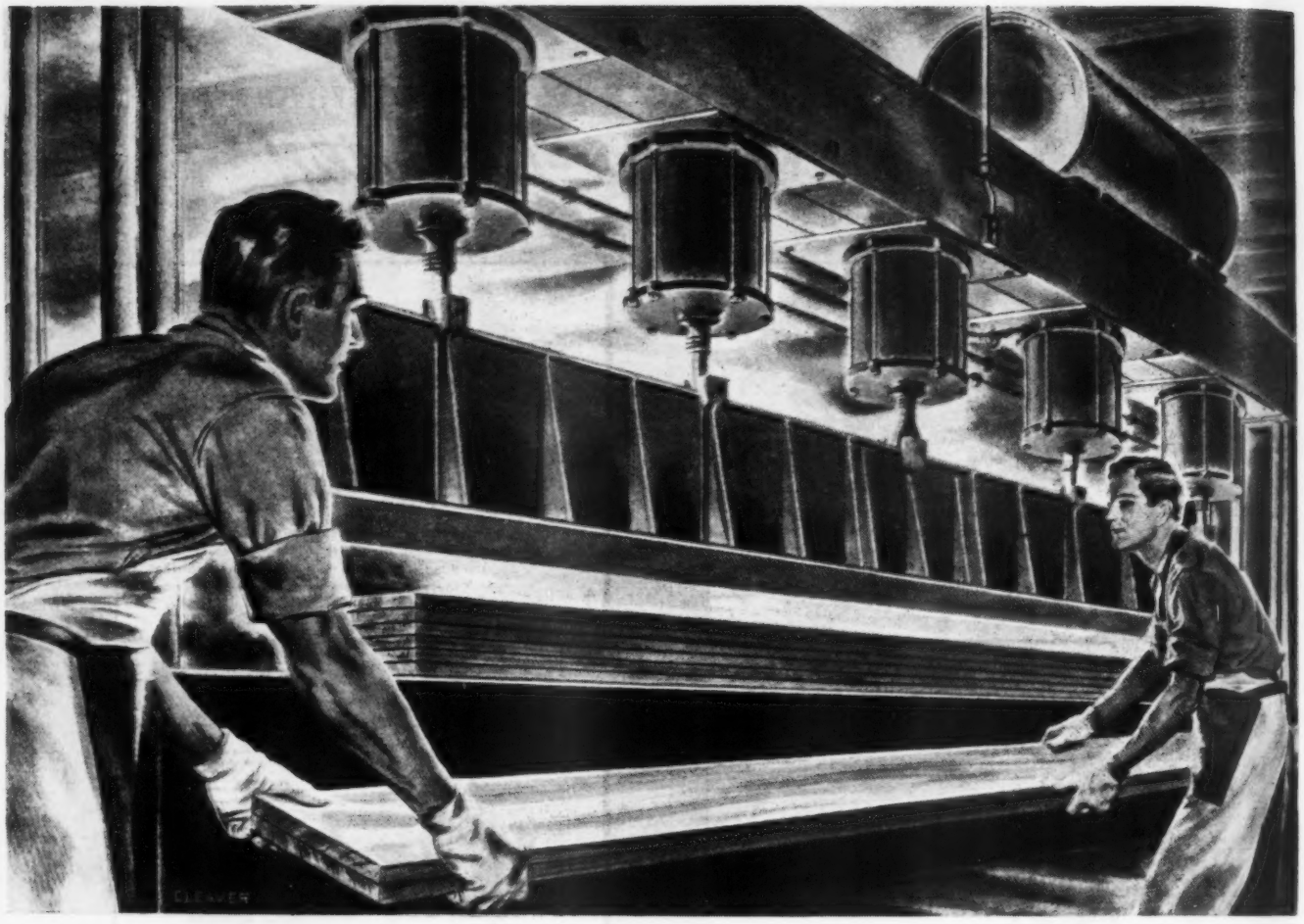
The variable air condensers of Radio Condenser Company are today being used by our armed forces . . . not only on radio apparatus in tanks, but on planes and all types of radio communication sets.

This means, currently, that we are engaged 100% in war work. But, after the war, we will again be in a position to provide manufacturers of radio sets with a new, modern line of air condensers and push button tuning devices. So, in planning your post-war radio manufacture, plan to use Radio Condenser Company products.

RADIO CONDENSER CO.

CAMDEN, N. J.

RADIO CONDENSER CO. LTD., TORONTO, CAN.



How RCA Electron Tubes Speed Wood Bonding 700%

Electronic Heat Helped Tolerton Lumber Co. Multiply Production of Wooden Aircraft Members.

A CRITICAL shortage of Grade A spruce of adequate size threatened to limit manufacture of wood aircraft.

As solid planks from which wing spars were cut became harder and harder to find, manufacturers resorted to ingenious bonding together of easily available, random pieces, but production time and costs increased sharply.

To lick this new problem, the Tolerton Lumber Co., Alliance, Ohio, applied electronic heating.

They developed methods by which electronic heating "set" glued joints in 2 minutes . . . instead of hours as formerly required by cold-setting. They found that it took only 20 minutes for electronic heat to bond several planks into a laminated 6" x 6" x 16½' beam . . . as against 4 hours in a hot-platen press!

Electronic heat at Tolerton is provided by an RCA 16-kw electronic generator, in which power from the commercial supply is converted from a frequency of 60 cycles to 10 million cycles. Two RCA Type 892-R oscillator tubes and six RCA Type 872-A/872 rectifier tubes are used.

Results:

1. The Tolerton plant output jumped from 25 to 200 spars per day, because of shortened press time.
2. The setting of the glue is complete, because electronic heating produces uniform temperature throughout the glue line.
3. Lumber costs were cut about 40% by use of odd pieces.
4. In tests, the joints proved stronger than the wood itself 100% of the time — well above the government specifications.

Other Applications By Tolerton: Mr. R. I. Tolerton, Vice President of the Tolerton Co., reports that "we are also using this electronic method of gluing in the manufacture of lithograph backing blocks, steel-mill hammer boards, and 6-inch square maple blocks, which are later turned to make wheel-bearings for bombers. In each case the result has been important savings in time and expense, and more accurately made products because of the better glue adhesion obtained by electronic heat."

For Further Information on the Tolerton operation, send for free 8-page article, "Electronic Heating Sets Glue in Laminated Aircraft Spars." For examples of electronics at work in our own factories, send for the free 32-page booklet, "Electrons in Action at RCA." Address all inquiries to RCA, Commercial Engineering Section, Dept. 62-50Y, Harrison, N. J. If you have any problem involving the use of electron tubes, RCA tube-application engineers will be glad to help you or to put you in touch with a manufacturer who can.

Remember, the Magic Brain of all electronic equipment is a tube . . . and the fountainhead of modern Tube development is RCA.

BUY MORE WAR BONDS

RCA

62-6336-30

RADIO CORPORATION OF AMERICA

RCA Victor Division • Camden, N. J.

SATISFYING THE WORLD'S TOUGHEST CUSTOMER

INVISIBLE ARMOR

Around every American vessel in dangerous waters today is a broad band of "invisible armor" – the electrical field of a DeGaussing belt – protecting it against magnetic mines.

These mines took a terrific toll of shipping early in the war. Buried deep in the sea they were difficult to detect and remove. Any ship passing within the magnetic field of a mine detonated it; force of the explosion was sufficient to crumple steel hulls many feet away.

Prompt installation of DeGaussing equipment was the answer to this enemy weapon. Star was called upon to help. Here again the U. S. Navy was a "tough customer" to satisfy – the Bureau of Ships demanded motor-generator sets that established new standards for compactness and ability to resist shocks and strains; called for quick delivery.

While the Navy does not endorse any product, the fact that Star was able to design and build the special equipment for DeGaussing installations, and maintain unfailing delivery schedules, is ample evidence of the high engineering skill of this organization. That engineering skill is available for your use in solving industrial motor problems. Star Electric Motor Company, 200 Bloomfield Avenue, Bloomfield, New Jersey.

Let Us Help Solve Your Special Problems

Motor-generator set, above, was designed and built by Star to meet special U. S. Navy requirements on voltage, compactness, resistance to shocks and strains. Occupies only half the space required for comparable sets.

Star's record in designing motors and generators for many Navy needs is proof of our ability to solve your difficult motor problems. A standard Star (⅛ to 200 H.P.) may handle your job; if it doesn't we'll build one that will. Discuss your post-war plans with us now.

ARMY E NAVY

STAR MOTORS

POWER PACKAGED AS YOU NEED IT

Here's information you can use, NOW!

New FIBERGLAS* ELECTRICAL INSULATION MATERIAL BOOKLET . . . TELLS WHAT TYPE TO USE, WHERE AND HOW . . .

This free, new booklet will be helpful to anyone concerned with the specification or application of electrical insulation.

It will help you determine which of the many types of Fiberglas electrical insulation materials should be used for a specific job.

The booklet will show you where this better insulation material can be used advantageously for electronic, radio and electrical applications.

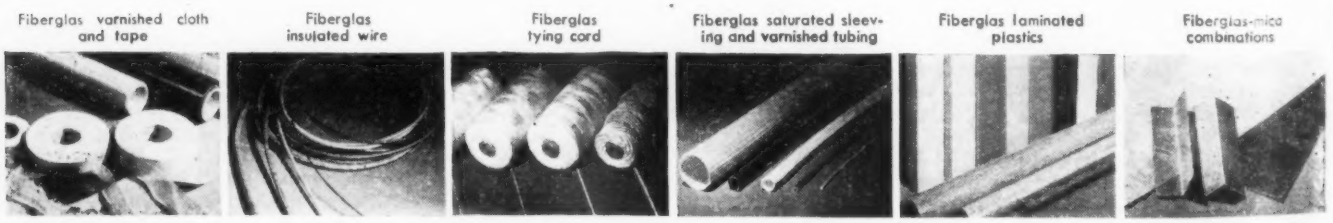
It will indicate the ways to use Fiberglas electrical insulation material to obtain all of the benefits which it affords.

Containing complete information about Fiberglas, the new booklet illustrates Fiberglas fibers and filaments twisted into yarns, served on wires, woven into tapes and cloths, braided into sleevings and formed into tying cords.

It describes the unique combination of electrically and mechanically important characteristics of Fiberglas such as: high temperature, moisture and acid resistance, favorable space factor and high tensile strength. It shows how the insulating impregnants increase the effectiveness of Fiberglas' inherent characteristics and add others such as high dielectric strength, insulation resistance and resistance to abrasion.

You will see why the use of this basic, inorganic, insulating material is increasing so rapidly—why so many designers, manufacturers and repair shop operators prefer it.

Be sure to have a copy of this new booklet in your file for ready reference. Write for your copy today—there is no obligation. Address: *Owens-Corning Fiberglas Corporation, 1869 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*



FIBERGLAS

*T. M. Reg. U. S. Pat. Off.

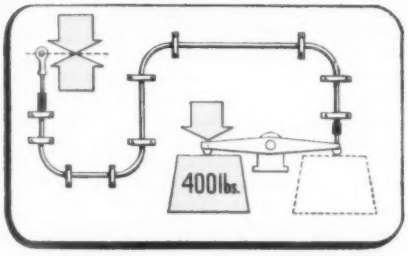
ELECTRICAL INSULATION MATERIAL

Dependable *all around duty assured with* Simmonds Push-Pull Controls

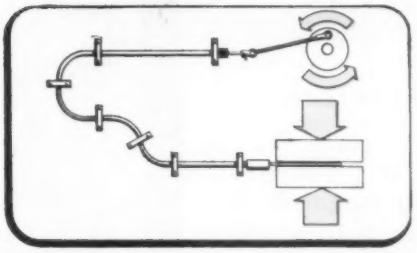
Read how these other tests, conducted to AAF specifications, show how Simmonds products more than qualify for EXTRA DUTY as well as NORMAL DUTY operations.

FIRST TO CARRY THE YELLOW DOT

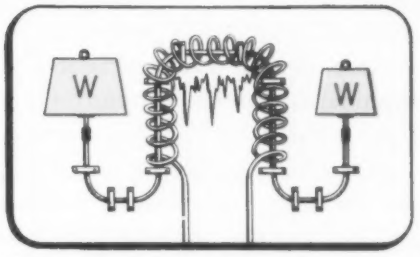
of Army Air Force Winterization acceptance for operation in extreme temperatures is the Simmonds-Corsey Push-Pull Control. Comprehensive tests with temperatures as low as minus 72°F. and as high as 160°F. prove efficient operation under wide variety of conditions.



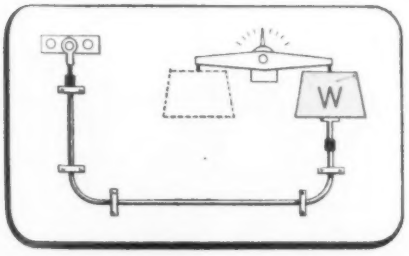
STATIC STRENGTH: *In this test Simmonds push-pull control successfully withstands tensile and compressive forces of 400 lbs. Credit simplification of design, improved linkage.*



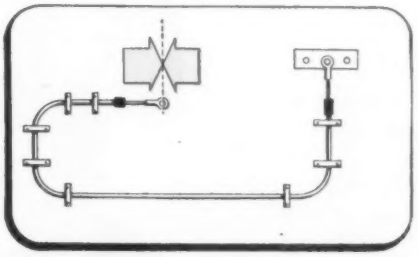
ENDURANCE: *Cycled 30,000 times under stress, as illustrated, Simmonds controls are not affected in any way, and can be expected to outlast the life of unit served.*



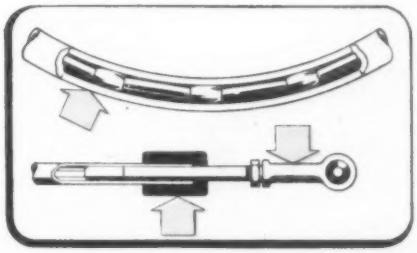
EFFICIENCY: *Input-output ratio of control is measured at various temperatures in insulated chamber. Result: average efficiencies are twice the AAF requirements.*



PRECISION CONTROL: *Motion between tension and compression is negligible. Before endurance test: average—.046"; after—.082". Simmonds are precision-built controls.*



DEFORMATION: *AAF specifications call for loads ranging from 10 to 50 lbs. Allowable average deformation is .140". Simmonds controls average only .083".*



CORROSION: *Simmonds controls meet AAF specifications for corrosion resistance with standard cadmium plated or anodized surfaces. Tube ends are rubber sealed.*

INQUIRIES concerning War Contracts or Post-War problems involving push-pull control equipment are invited. Our service engineers will furnish you gladly with analyses and recommendations. Telephone or write to your nearest Simmonds office.

SIMMONDS EQUIPMENT FLIES WITH EVERY TYPE OF ALLIED AIRCRAFT

Automatic Engine Controls — Push-Pull Controls — Spark Plugs
Hydraulic Accumulators — Hydraulic Fuses — Chronometric Radiosondes
Self-Aligning Rod-End Bearings — Fasteners and Clips of Specialized Design

30 Rockefeller Plaza,

SIMMONDS AEROCESSORIES INC.

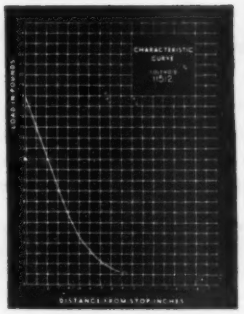
New York 20, New York

Branch Offices: Dayton • Washington • Hollywood • Montreal

Manufacturing Plants: New York • Vermont • California

Faster, more efficient operation with CANNON D.C. SOLENOIDS

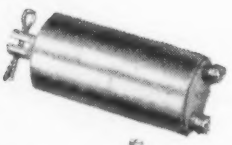
With Cannon Electric D. C. Solenoids you get automatic trigger-action. Solenoid pull is positive. Cannon Solenoids may be operated without damage to a maximum temperature of 200 degrees C.

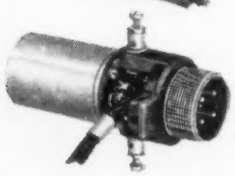


Response characteristic charts like the above (test at 28 volts) are found in Solenoid Bulletin.

A wide selection of Cannon Solenoids are built for various combinations of voltages, pull, armature travel, duty cycle, etc. to suit design requirements. Nominal voltages are 12 and 24; others by special order. Eight types have "holding" features.

As a reliable means of controlling or operating various devices, they are used for retarding magnetos in starting engines, operating hydraulic valves and mechanical clutches, firing machine guns, arming and releasing bombs, dropping auxiliary fuel tanks, locking retracting gears, film-winding mechanisms and for shutter control on special cameras. These are only a few of the possible applications.





A copy of the Cannon Electric Solenoid Bulletin—34 pages of diagrams, data and photos of the complete line will be sent free for the asking. Address Dept. A-106, Cannon Electric Development Co., 3209 Humboldt Street, Los Angeles 31, California.

Also manufacturers of Electrical Connectors

CANNON ELECTRIC

Cannon Electric Development Co.
Los Angeles 31, Calif.

Canadian Factory and Engineering Office:
Cannon Electric Company, Limited, Toronto

Representatives in Principal Cities—
Consult Your Local Telephone Book

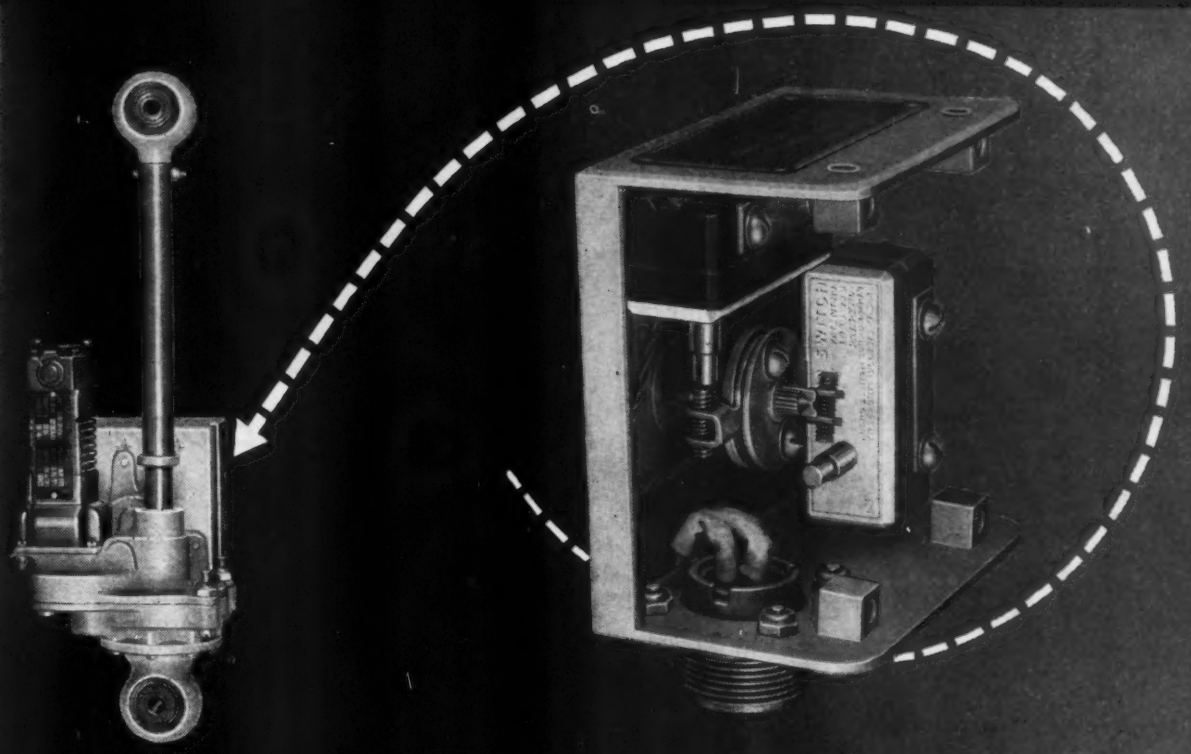
IT'S TIME TO INVESTIGATE TIMERS

WHEN PLANNING to build new machinery and equipment . . . or to improve old models . . . be sure to get full information about Paragon Automatic Time Controls. These instruments, when built into numerous types of equipment, save time . . . multiply human output . . . reduce errors . . . increase efficiency . . . and lower costs. They can improve the salability and usefulness of innumerable products and help meet postwar competition.

HUNDREDS OF APPLICATIONS—Some of the numerous applications of timers are: Protecting component parts, such as electronic tubes . . . Automatically turning air conditioning units on and off . . . Sequence Timing . . . Laboratory Testing . . . Conveyor Control . . . Light Exposure . . . Heat Treating . . . Pump Operation . . . Machinery operation . . . Plastic Molding . . . Time delay on pump back spin . . . Controlling pre-heating schedules.

ASK PARAGON ENGINEERS . . . about the application of time controls to your problem. Since 1905 these engineers have designed, manufactured and field-studied the operation of industrial timers, time switches, time delay relays and interval timers. They will study your problem and make recommendations without cost or obligation.

PARAGON ELECTRIC COMPANY
708 Old Colony Building
Chicago 5, Illinois



LEAR AVIA, INC. RELY ON MICRO SWITCHES FOR INSTANT, PRECISE CONTROL OF ELECTRO-MECHANICAL ACTUATORS

Micro Switches are responsible for the accurate operation which has made Lear Actuators ideal components for use in military aircraft.

Lear Avia, Inc., Piqua, Ohio, who build these light, powerful electro-mechanical devices, find Micro Switches provide the precise, instant control required yet keep within the required limits of small space and light weight.

This small Lear Actuator shown here weighs but 3.3 pounds. Yet it is capable of moving 1200 pounds. Rotary type Lear Actuators are capable of operating torques from 400 inch-pounds to 6500 inch-pounds.

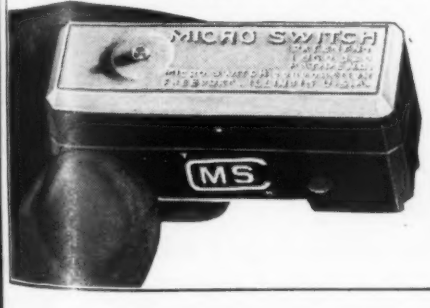
Lear Actuators must operate instantaneously. Micro Switches, used in pairs, cause the unit to start or stop at the exact point of predetermined setting in the control box. The first Micro Switch limits the actuator travel in one direction, the second Micro Switch serves as the limit to travel in the other direction. Lear Actuators may be controlled by manual switches, thermostats, pressure switches, etc.

Micro Switches were selected by Lear Avia, Inc. because a sensitive and precise limit switch was required to provide the accuracy of control necessary. The quick make-break action of Micro Switches was also found to assure long operation life on severe direct current loads. No unit failure due to faulty Micro Switches has ever been recorded.

Designers and production engineers who are letting pre-conceived ideas go by the boards . . . seeking a new way . . . will do well to investigate Micro Switch. This tiny, snap-action electric switch can be counted on for any application where a small, precise, sensitive switch is required that will respond accurately to actuating motion through millions of repeat operations.

Micro Switches provide over 2700 variations . . . combinations of housings, actuators and electrical characteristics. For complete information, send for Handbook-Catalog No. 60. If your application is for aircraft use, also send for Handbook-Catalog No. 70.

The basic Micro Switch is a thumb-size, feather-light, plastic enclosed, precision, snap-action switch, Underwriters' listed and rated at 1200 V.A., at 125 to 460 volts a-c. Capacity on d-c depends on load characteristics. Accurate repeat performance is experienced over millions of operations. Wide variety of basic switches and actuators meets requirements varying from high vibration resistance to sensitivity of operating force and motion as low as 2/1000 ounce-inches. Many types of metal housings are available.



LET'S ALL BACK THE ATTACK— BUY EXTRA WAR BONDS

Micro Switch Corporation, Freeport, Illinois • Branches: 43 East Ohio Street, Chicago (11) • 4900 Euclid Avenue, Cleveland (3) • 11 Park Place, New York City (7) • 1709 W. 8th St., Los Angeles (14) • Sales & Engineering Offices: Boston • Hartford • Portland, Ore. • Dallas, Tex.

"Uses Unlimited"—a dramatic talking motion picture of Micro Switches, in color, is available to industrial groups, training classes, schools and colleges, through Y.M.C.A. Motion Picture Bureau, New York, Chicago, San Francisco. Size: 16 mm. Length: 40 minutes. Write us for details.

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MICRO MS SWITCH
TRADE MARK

MADE ONLY BY MICRO SWITCH CORPORATION
FREEPORT, ILL., U.S.A.

How to . . . REDUCE Size and Weight or INCREASE the Action of THERMAL CONTROLS

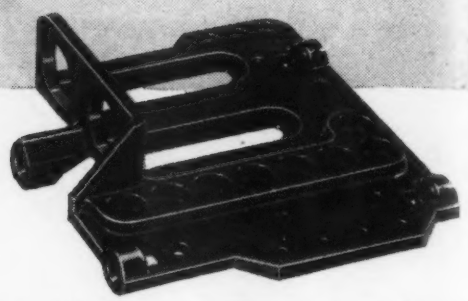
Control elements made of Chace Thermostatic Bimetal No. 6650 may be made 40% smaller than like elements made of any other known bimetal and still give you the same thermal deflection and spring rate . . . thus your entire control may be designed to occupy a smaller space and weigh less, without sacrificing thermal action.

Or you may increase the thermal deflection of any given size element at least 40% by substituting Chace No. 6650 . . . thereby increasing the sensitivity without increasing the size of your thermal control.

Chace Thermostatic Bimetal No. 6650 offers you a decided advantage in thermal deflection, a higher spring rate per °F., and a high degree of electrical resistivity . . . If you are interested in reducing the size or weight, or increasing the action of a set size of thermal element, send for Bulletin No. B-145 which gives complete information concerning this most exceptional thermostatic bimetal.

W.M. CHACE CO.
Manufacturers of
Thermostatic Bimetals and Special Alloys
1607 BEARD AVE • DETROIT 9, MICH.

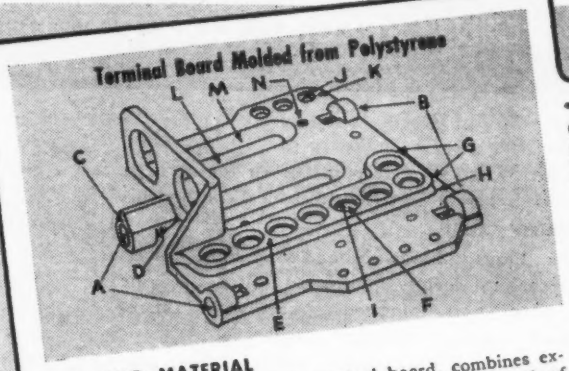
17th



Recipe for an Economical ELECTRICAL PART

Mix design requirements with Aico's comprehensive experience in working with all types of plastic materials and molding methods. The finished product is an electrical part that meets the most rigid specifications.

The terminal board (shown above) for use in a portable megohmeter is an example of the prominent role which plastics are playing in the electrical field. Since it is used in an instrument for measuring insulation resistances, it must have, above all, superior electrical properties. Aico's knowledge of materials, design and engineering, insured the selection of the *right* material to meet performance requirements . . . the *right* molding method for greatest economy and rapid production.



POLYSTYRENE TERMINAL BOARD

MOLDING MATERIAL
Polystyrene, chosen for this terminal board, combines excellent electrical properties, lightness in weight, and lack of moisture absorption with suitability for the rapid injection molding method. These advantages make polystyrene especially desirable for an application of this kind.

MOLD DESIGN AND CONSTRUCTION
The necessity for holding close tolerances throughout . . . plus the varied design elements involved . . . demanded extremely accurate and complicated mold construction. The part is formed in a single cavity mold with side action to mold horizontal holes (A and B). Extra thickness is provided for greater strength (at points C and D) where projecting unit joins the part proper. The thick wall section (E) strengthens part in area which would otherwise be weakened by holes (F). This section (E) has rounded corners (G) and fillet (H) which curve into the top surface of the board for easier removal from the mold. Note the shoulders (I) in these holes (F). The irregular counter-sunk shoulders (J) in small holes (K) are part of the design requirements produced in one single economical operation. Elongated openings (L) have beveled sides (M). Small holes (N) are threaded.

**This is the 17th of Aico's plastic applications file cards. Write on your letterhead for a complete set from 1 to 17.*

Aico
AICO
PRECISION MOLDING
29th Year
AMERICAN INSULATOR CORPORATION
NEW FREEDOM, PA. Sales Offices: Boston • Bridgeport • Buffalo
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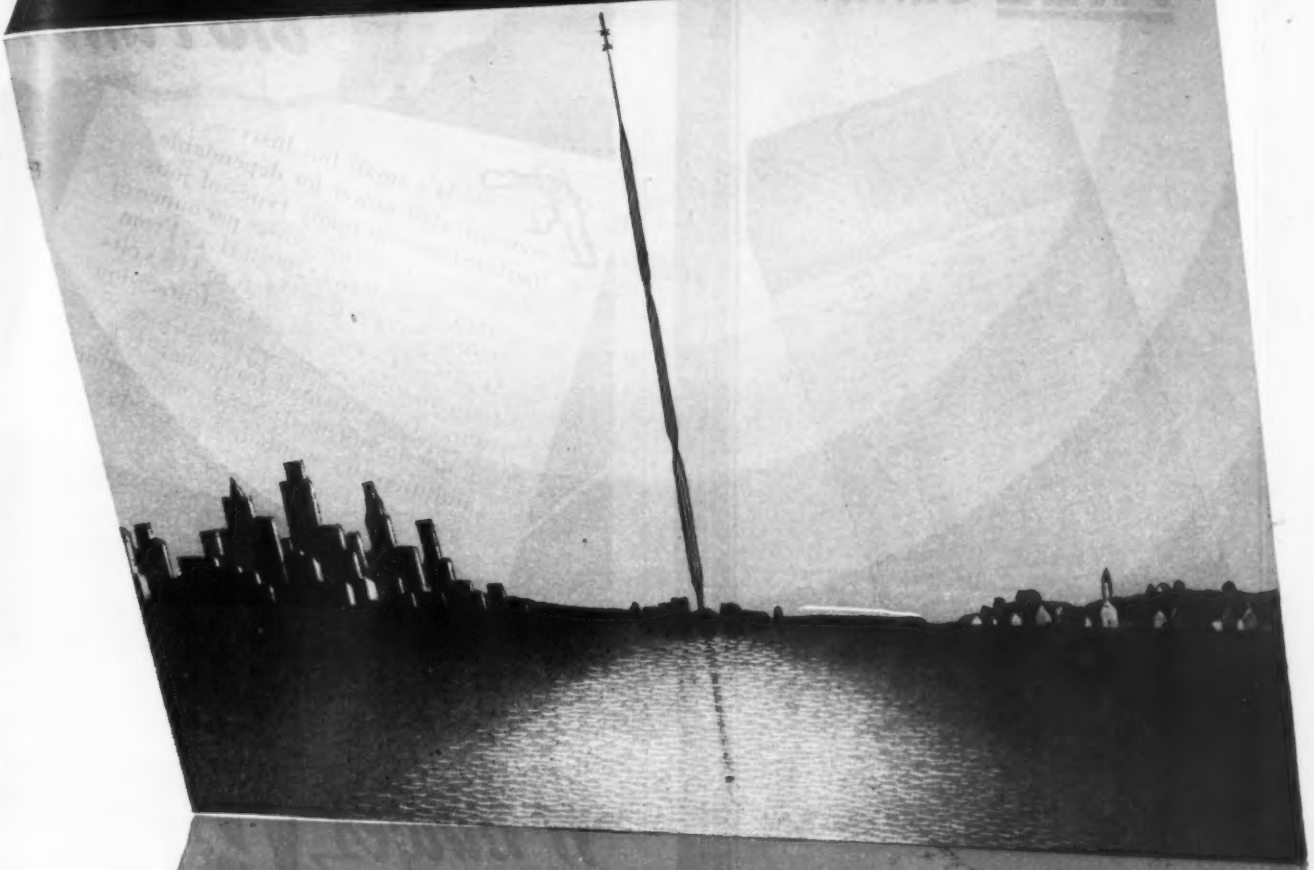
LOOKING AHEAD



New ideas and new devices come thick and fast in wartime. America's manufacturers have worked tooth and nail with the Army and Navy to produce all the modern equipment the armed forces need.

Among these manufacturers is Lear. The Lear aircraft radio was well known long before the war. It was ready for the armed forces when war came. Then Lear explored new fields and produced the special Lear midget motors, the Fastop Clutch, and Lear Actuators which make it possible to move airplanes' flaps, shutters and landing gears accurately by electricity.

All Lear wartime developments couldn't be mentioned here. Many of them and the engineering ingenuity which produced them will be turned to peacetime conveniences and pleasures.

For example, there will be the new Lear home radios — instruments built with the integrity demanded by aircraft radio, and equipped with features unknown in such sets before.

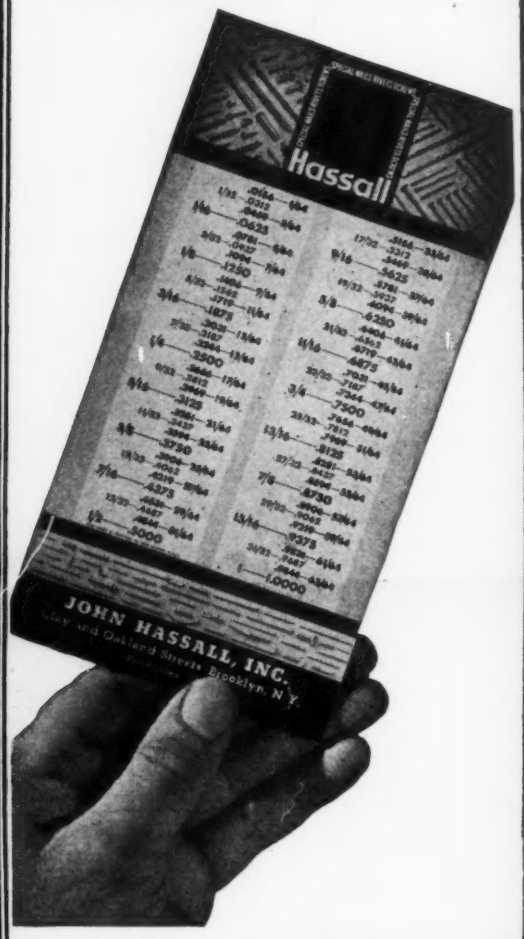
So while everything keeps going to get wartimes over with, we can afford a look ahead to the bright spots in the peace we have been fighting for.

RADIO DIVISION, GRAND RAPIDS 2, MICHIGAN
Home Radio Sales: 230 East Ohio St., Chicago 11, Illinois

formerly Lear Avia, Inc.

Lear INCORPORATED

Send for this
FREE CHART



Decimal Equivalents. Accurate to four places. Signaled in three colors for maximum speed in locating decimal equivalent of fraction. Saves time and avoids errors. Yours at no cost or obligation. Just send us your name, title and address.

See our Catalog in Sweet's File for Product Designers

JOHN HASSALL, INC.
Specialists in Cold Forging Since 1850
402 Oakland Street · Brooklyn 22, N.Y.

SPECIAL NAILS RIVETS SCREWS
Hassall

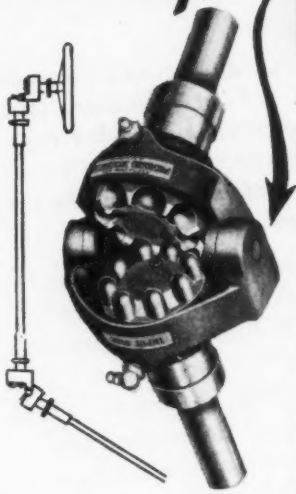
IT PACKS A *BIG PUNCH*

It's small but lusty—concentrated power for dependable performance on many types of jobs requiring maximum power per ounce of weight. 1/20th to 1/200th H.P. From 3000 to 20,000 R.P.M. 6 to 115 volts AC-DC. It's engineered and precision-built to your exact specifications. What type of small fractional H.P. motor do you need? Send specifications and quantity wanted. Write today.

Design
Engineering
Production

Small Motors, Inc.
1320 ELSTON AVE., CHICAGO 22, ILLINOIS

It Hinges Piezo



• • • HINGED GEAR UNIVERSAL JOINT

is designed for the remote control of valves, dampers, ventilators, etc. It is constructed of two matched manganese bronze gears in a hinged housing which permits the operation of shafts at angles from in line to 92°. The flexibility of this unit simplifies remote control installations. Positive and smooth action is guaranteed.

Write for your free copy of the Piezo catalog containing installation accessories and complete unit specifications.

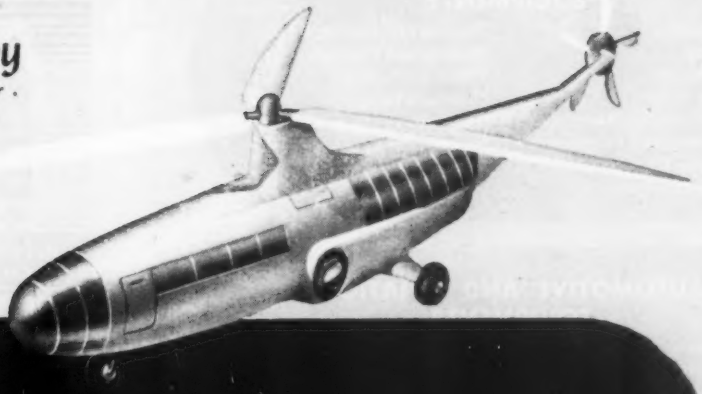
PIEZOELECTRIC CORPORATION
110 E. 42nd ST., NEW YORK 17, N. Y.

Piezo
UNIVERSAL
GEAR JOINTS

I PREDICT...

by Raymond Loewy

Noted Industrial Designer



After the war you will travel more than you ever have. And one of the developments that will make it possible is the new helicopter air bus. This remarkable aeronautical achievement ushers in a really new mode of transportation that will enable you to make short air trips quickly, inexpensively and in complete comfort. Present bus terminals will be adapted as landing ports and maintenance hangars so you will take off and arrive in central sections of cities and towns. The multi-passenger helicopter air bus, already endorsed by authorities as entirely practical, will bring air travel to millions of persons and thousands of communities that now lack this form of transportation. When you buy War Bonds today remember they will enable you to experience this and many other marvels in tomorrow's world!

* * *

Note: The Weatherhead Company, one of the oldest and most important manufacturers of parts for the aviation industry, is prepared for the day when its four plants will again be contributing to aviation's peacetime needs.

Look Ahead with ⟨W⟩

Weatherhead

THE WEATHERHEAD COMPANY, CLEVELAND, OHIO

Manufacturers of vital parts for the automotive, aviation, refrigeration and other key industries.

Plants: Cleveland, Columbia City, Ind., Los Angeles
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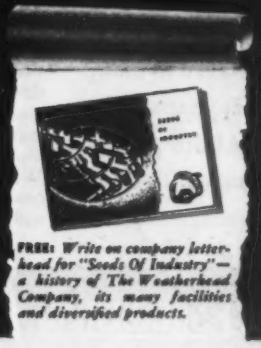

FREE: *Write on company letterhead for "Seeds Of Industry"—a history of The Weatherhead Company, its many facilities and diversified products.*

DO YOU MAKE:

RADIO, SOUND AND COMMUNICATIONS EQUIPMENT?

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IF YOU make any of the above products, it will pay you to find out how *better permanent magnets* can improve efficiency and reduce costs. Put your design, development or production problems up to The Arnold Engineering Company. Arnold engineers have been of great assistance to many manufacturers and are at your service to advise exactly what Alnico permanent magnet will solve your particular problem.

NEW! Get your copy of this valuable, up-to-the-minute manual on the design, production and application of modern Alnico permanent magnets. Write us, on your company letterhead, today.

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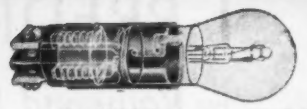
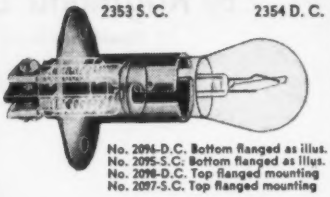
147 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS
Specialists in the manufacture of ALNICO PERMANENT MAGNETS

SOCKETS
ENGINEERED BY Cole-Hersee
FOR NEW TYPE OF NEON AND ARGON GLOW LAMPS

SINGLE CONTACT SOCKETS



2353 S. C. 2354 D. C.



No. 2096-D.C. Bottom flanged as illus.
No. 2095-S.C. Bottom flanged as illus.
No. 2098-D.C. Top flanged mounting
No. 2097-S.C. Top flanged mounting

FOR THE FOLLOWING NUMBERS
NE-42
NE-36
NE-32
NE-26
NE-48
NE-15
NE-21
NE-17
AR-2
AR-4

DOUBLE CONTACT SOCKETS

For Miniature Base Single Contact Only

SOCKET	SOCKET HOLDER
No. 2501 Diameter .425 in.	¾ in. Long Brass, Nickel Plated
No. 2502 Diameter .425 in. 17/32" Long	Sleeve No. 2902 Socket and Sleeve Both Brass, Nickel Plated
No. 2503 Diameter .425 in. 21/32" Long	Holder No. 2903

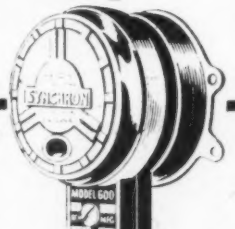
Heavy Screw Terminals permit easy attachment of resistors and wire leads

If you have a problem in switch or socket application bring it to Cole-Hersee for prompt action.

Cole-Hersee Company
54 OLD COLONY AVE. BOSTON 27, MASS

If you make timing machines, time recorders, time switches or any other type of timing device—you should get the facts about SYNCHRON Synchronous self-starting motors—

These tiny SYNCHRON motors are compactly built, with rotor and coil nested in a sturdy, streamlined case 2¾" x 1-5/16" — with power to pull 8 oz. direct load continuously at 1 RPM.

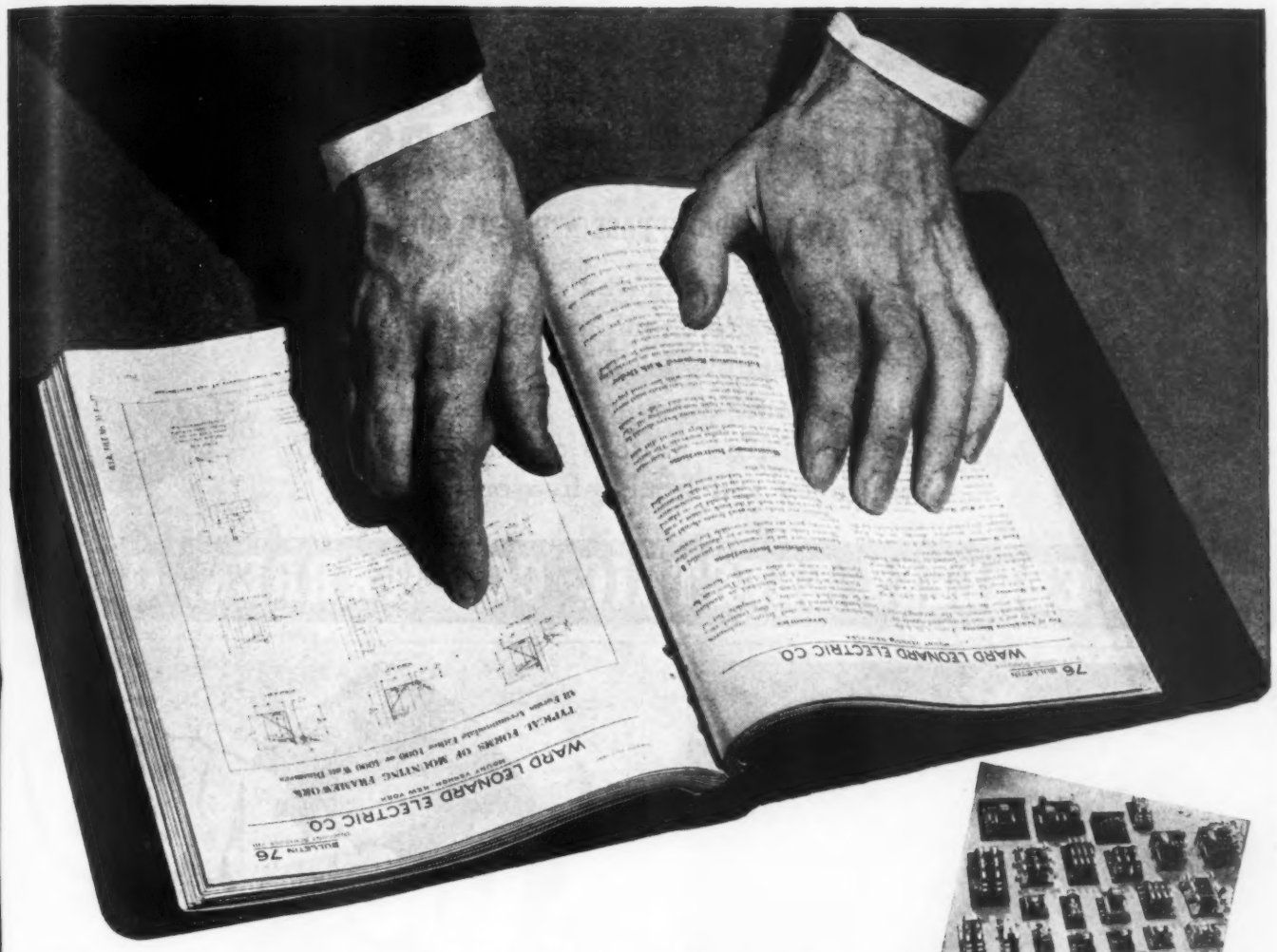


Complete customer satisfaction is assured by precision construction in every detail; including specially hardened steel shafts, polished brass gears, with oil-impregnated double bearings, and positive life-time lubrication. Pre-tested, to operate at 40 degrees below zero or 140 degrees above.

Standard SYNCHRON Motors are available in speeds from 1 to 300 RPM, clockwise or counter-clockwise, in all voltages and cycles. And other speeds can be furnished to meet special requirements. Write HANSEN MFG. CO., INC. at Princeton, Indiana for catalog and prices.

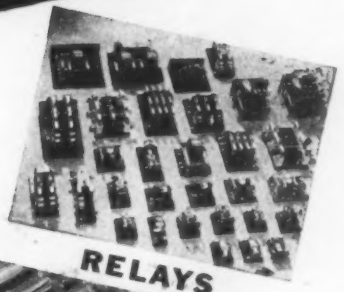
SYNCHRON
TIMING | MOTORS

NO LOST TIME FOR *Reconversion*



These Controls Are Ready

Practically every Ward Leonard Product used for war purposes required little or no equipment change. The controls of the machines of peace are essentially the same controls of machines of war. Hence, when the entire facilities of Ward Leonard were needed for the war emergency, production went on as usual, only in greater magnitude. Those same facilities are available for postwar production as and when they are released from war service. Again the change-over will be made without delay as there is no need for reconversion. The products are the same except for specifications and will be made by the same workers and same machines. When planning the controls for your postwar products, you will save time and money and be assured of war-tested units, controls and assemblies by making your selection from the Ward Leonard line. Send for bulletins describing controls of interest to you.


RELAYS

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RELAYS • RESISTORS • RHEOSTATS

Electric control (WL) *devices since 1892.*

WARD LEONARD ELECTRIC COMPANY · 63 SOUTH ST. · MOUNT VERNON, N. Y.

Peerless QUALITY MOTORS

SINGLE PHASE • POLYPHASE • DIRECT CURRENT

Fifty-one years in the production of quality electrical equipment have given Peerless engineers and craftsmen proficiency and experience in designing and building motors of maximum efficiency and trouble-free operation.

THE PEERLESS ELECTRIC CO., WARREN, OHIO

Try TUTTLE *First*
for THOSE SPECIAL RESISTANCE WINDINGS

Fussy jobs—quick deliveries—we have the equipment and the skilled labor to do them.

Strip Resistors—Porcelain Heating Elements—Special and Standard Heating Elements.

—Send us your specifications for quotations.

Write for Bulletin S101B

H. W. TUTTLE & COMPANY•ADRIAN, MICH.

After the Others Failed

SpeedWay's "know how" was able to develop new gearmotor designs for the Armed Forces that did the required job. Today, expanded needs for these motors take SpeedWay's capacity, as well as the capacities of other large motor manufacturers, *working to SpeedWay Specifications.*

If you need motors or gearmotors for a standard or special application, bring your problem to Speedway. Motor outputs range from 1/3000 to 1/3 h.p. Unlimited gear ratios available from stock gears. Write for our recommendations on your war or postwar problem.

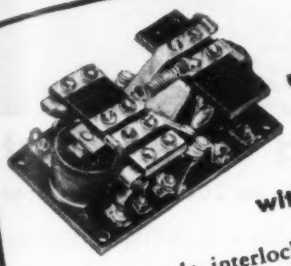
Write for SpeedWay's new Motor Bulletin showing standard A.C., D.C., and Universal Motors and gearmotors.

SPEEDWAY MFG. CO. 1846 S. 52nd Ave., Cicero 50, Ill.

FIVE OF THE 5,312 RELAY TYPES

A NEW "MEMORY" RELAY

with simplified interlock



A new style interlock represents latch-in relay construction in its simplest, most dependable form. Design of this Struthers-Dunn 50XBX series simplifies make-before-break, or break-before-make contact combinations. Contacts do not interrupt coil circuit until the "throw" is completed and they are latched in new position. Built to aviation specifications.

VACUUM SWITCH KEYING RELAY

The extreme reliability with which this Struthers-Dunn Type 78CCA100 Vacuum Tube Keying Relay holds its adjustments is the direct result of a rigid and simplified design utilizing an absolute minimum of parts. Exceptionally sturdy—designed for aircraft. All parts readily accessible.

7 poles including one D.T. pole handling high-voltage r-f currents by means of a vacuum switch. High-voltage parts rounded to reduce corona.

SENSITIVE SNAP-ACTION

in a new, simplified design

Applications for the Struthers-Dunn Type 79XAX Sensitive Snap-Action Relay range from vacuum tube circuits, to overcurrent protection, pulsing circuits, and jobs where extremely close differential or extreme sensitivity are required. Contacts remain in position *with full pressure* up to the instant of transfer. Write for Bulletin No. 251.

SHOCKPROOF to 90 G's

Here's a relay that won't operate unintentionally as a result of shock or vibration—the Struthers-Dunn Type 17AXX designed to meet exacting B2A specifications. Small in size, light in weight, it meets and exceeds all specifications for such services.

WRITE—*for your copy of the big Struthers-Dunn Relay Catalog and Data Book . . .*

EXTRA HEAVY-DUTY CONTACTS

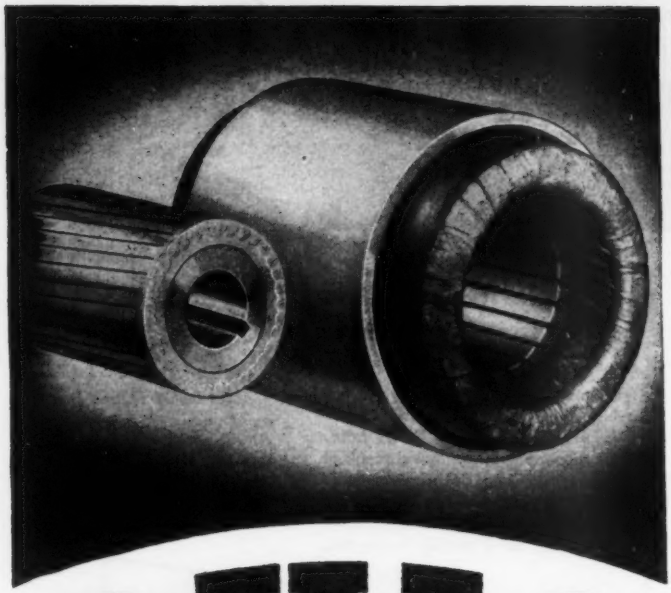
Struthers-Dunn Nutcracker Type 61HXX100 meets the call for relays for extreme services, particularly where severe overloads may cause trouble on units having a less generous heavy-duty contact safety factor. Typical applications include those such as aircraft landing light controls, or controlling a number of solenoids simultaneously. Readily adaptable to different specifications.

STRUTHERS-DUNN, INC., 1321 ARCH ST., PHILA. 7, PA.

STRUTHERS-DUNN

5,312 RELAY TYPES

DISTRICT ENGINEERING OFFICES: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND DALLAS • DENVER • DETROIT • HARTFORD • INDIANAPOLIS • LOS ANGELES • MINNEAPOLIS • MONTREAL NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO • WASHINGTON



OHIO

Shell Type MOTORS

Compact and Efficient

Design is often facilitated and efficiency increased by making the motor an integral part of the machine or appliance. This type is particularly suitable where one of the motor speeds available is directly applicable to the purpose.

The stator is pressed into a heavy steel shell and the rotor is bored to your specifications. Rotor is dynamically balanced on a test shaft with key in place.

Ratings range from 1/4 to 7 1/2 HP; speeds, 1150, 1750 and 3500 rpm. Built for A.C. single-phase or multiphase currents.

OHIO MOTORS INCLUDE

Split-phase Induction to 1/3 HP	Shell Type to 7 1/2 HP
Direct Current to 1 HP	Torque to 100 oz. ft.
Capacitor to 2 HP	Shaded Pole to 1/30 HP
Polyphase to 2 HP	Synchronous to 1/4 HP
Aircraft Motors	A.C. to D.C. Motor Generators to 500 watts.

High to Low Voltage D.C. Dynamotors up to 300 watts.

Tell us your requirements and we will advise with you

THE OHIO ELECTRIC MFG. CO.
5911 Maurice Avenue Cleveland, Ohio

For Hardening Small Parts

175 to 2000 lbs. per hour

Uniformity—Scale-Free—Continuously

Products being treated in EF Chain Belt Furnaces, include:

- Sprockets
- Cap screws
- Bolts and nuts
- Gears and pinions
- Flat springs
- Coil springs
- Small forgings
- Valve springs
- Spring plates
- Tractor links
- Rivets and washers
- Wrench & tool parts
- Bearing parts —cups and cones
- Machine gun cartridge clips
- Aircraft engine parts
- Automotive parts
- Rock bits, and many other products

The above shows two EF chain belt furnaces we installed in one plant. Hundreds are in operation handling products such as listed at left. We build them for gas, oil or electrically heated.

The EF chain belt conveyor type furnace is one of the most satisfactory general purpose furnaces built for the continuous, uniform, economical production heat treatment of small and medium size products.

Send for circulars showing the chain belt and other types of EF production furnaces

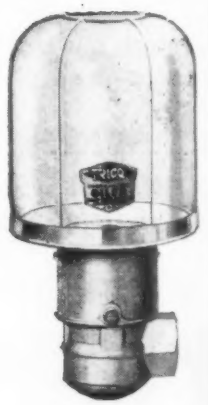
The Electric Furnace Co., Salem, Ohio
Gas Fired, Oil Fired and Electric Furnaces—For Any Process, Product or Production

MODERNIZE NOW
for the
POST-WAR MARKET

TRICO
REG. U.S. PAT. OFF.

Streamlined Unbreakable
OILERS

will help you in two ways:



Unbreakable Constant-Level Oiler

1—You have the assurance that your equipment will be provided with positive lubrication. That means: Longer life, low maintenance costs and customer satisfaction.

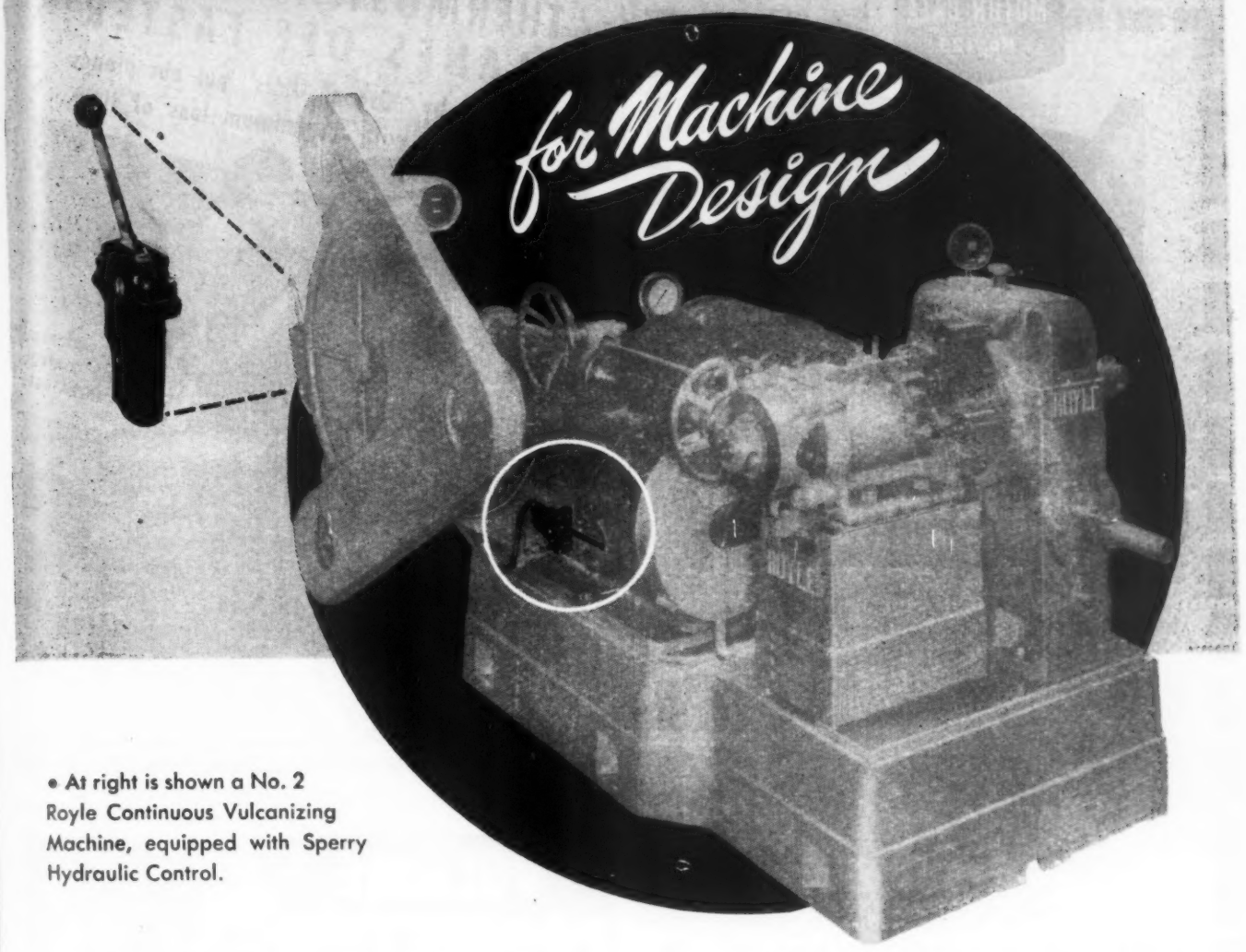
2—The entire appearance of your equipment is enhanced by the modern, streamlined design. It increases your prestige and reduces sales resistance.

WRITE FOR CATALOG

TRICO FUSE MFG. CO. Milwaukee, Wis.

SPERRY HYDRAULIC CONTROLS

for Machine Design



• At right is shown a No. 2 Royle Continuous Vulcanizing Machine, equipped with Sperry Hydraulic Control.

APPLICATION: Speed and accuracy control of wire-feed on Continuous Vulcanizing Machine manufactured by John Royle & Sons, Paterson, New Jersey.

PROBLEM: To obtain uniform speed of wire through extrusion machine to accurately control both the amount of insulation and the outside diameter of the wire. Previous control was by means of a manually-operated wheel which presented following difficulties:

a. Lack of convenient location for wheel control.

b. Production delays because of time required to obtain quick readjustment while the machine was in operation.

c. Doubtful quality control because of time lag between readjustment.

d. Increased operator fatigue, because of the time and effort required to manipulate wheel control.

SOLUTION: This leading manufacturer of machines for the rubber and plastic industry installed Sperry's Hydraulic Controls with the result that:

a. Operating difficulty was eliminated by use of a Sperry control in a convenient location.

b. Production was increased by quick, accurate readjustment.

c. Quality control was assured.

d. Operator fatigue eliminated.

The above case-history is typical of the advantages many manufacturers and users of industrial equipment obtain when they use Sperry's single-tube system to solve their remote-control problems.

Sperry's Hydraulic Remote Controls minimize design problems by utilizing a single connecting tube that can be bent around corners and pillars, and installed through walls and other obstacles, thus reducing installation and maintenance costs.

EASY INSTALLATION . . . DEPENDABLE . . . ACCURATE

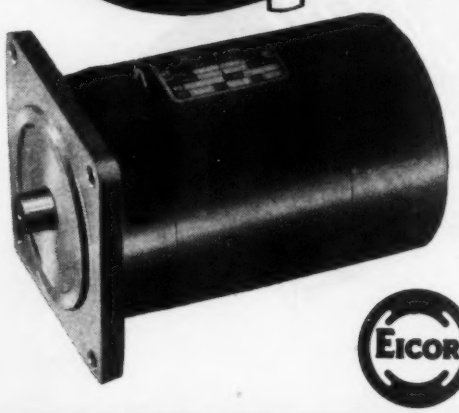
Send for Bulletin 78 for Additional Details

For Scientific **SPERRY** *Achievement*

SPERRY PRODUCTS INCORPORATED

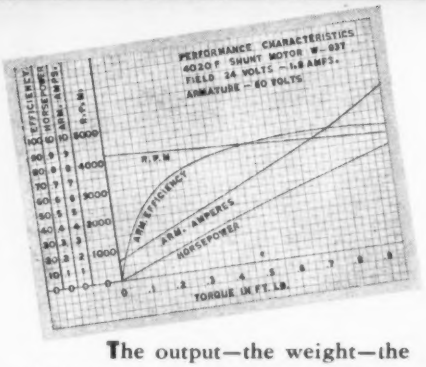
HOBOKEN, NEW JERSEY
CHICAGO, ILLINOIS

MOTOR DATA
No. 129



EICOR

4000 FRAME MOTOR
1/2 HP at 3900 RPM



The output—the weight—the size—of these 4000 Frame Motors are features well worth remembering. Every adaptation of the standard design is engineered for the precise requirements of an aircraft, portable, or industrial application.

FEATURES

ELECTRICAL	MECHANICAL
Series, shunt, or compound-wound	Ventilated or enclosed types
Unidirectional or reversible	Base or flange mounting
Optional torque	Operation in any position
Optional speed	Low space factor
Optimum efficiency	Ball bearing equipped
For control circuits	Optional shaft details
Electric braking optional	Rugged construction

4000 FRAME MOTORS		4020 Shunt	4020 Series
Watts, Output, Con.	(Max.)	375	746
Torque at 3900 RPM	(ft. lbs.)	.65	1.4
Torque at 6000 RPM	(ft. lbs.)		.88
Speed Regulation		8%	
Lock Torque	(ft. lbs.)	2.5	4
Volts Input	(min.)	12	24
Volts Input	(max.)	110	110
Diameter		4"	4"
Length Less Shaft		7⅛"	7⅛"
Shaft Dia.	(max.)	.625"	.625"
Weight	(lbs.)	9.2	9.2

EICOR INC. 1501 W. Congress St., Chicago, U. S. A.
DYNAMOTORS • D. C. MOTORS • POWER PLANTS • CONVERTERS
Export: Ad Auriemo, 89 Broad St., New York, U. S. A. Cable: Auriemo, New York

"THERMOSWITCHES" GET PLANES OFF FASTER!

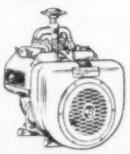
Heating by "Ground Units" put our planes in the air with a minimum loss of time.

Write for catalogue and complete information . . . to

Fenwal INCORPORATED ASHLAND • MASS.

VOLUME PRODUCTION
to meet the Growing Demands of War and Industry for

WISCONSIN Air-Cooled ENGINES



Highly systematized, progressive assembly of Wisconsin heavy-duty air-cooled engines keeps them coming off the production line in a steady, uninterrupted stream. Every operation is handled by a thoroughly trained workman who performs his specialized job with speed and skill.

The picture shows a run of Model VE-4, V-type, 4-cylinder engines going through . . . for power destinations on many types of equipment. Perhaps one of these heavy-duty engines has been reserved for service on *your* equipment.

Most H.P. per pound

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN, U. S. A.
World's Largest Builders of Heavy-Duty Air-Cooled Engines

Seven years ago we started out as a west coast distributor of aircraft parts. We named our company Aircraft Accessories Corporation. ● Then we started developing aircraft hydraulics. The next thing we knew we were full-fledged manufacturers—and out of the parts business. ● Later, someone came along with an embryo electronic plant in Kansas City. Being young and ambitious—we bought it. To everyone's amazement—and somewhat to our own—we made it grow. And pay.

NEW NAME NEW HORIZONS

We're still young, ambitious. Our explorations in hydraulics, electronics and other fields promise post-war growing pains. And so we've outgrown our name. ● Aircraft Accessories Corporation no longer adequately describes our operations. We couldn't think of a name that did. So we coined one: **Aireon.** It's a name that's partly aircraft, partly electronics; but it will be largely what we make it. We hope—and intend—to make **Aireon** worthy of a place among America's most honored corporate and trade names.

Aireon MANUFACTURING CORPORATION
Formerly *AIRCRAFT ACCESSORIES CORPORATION*

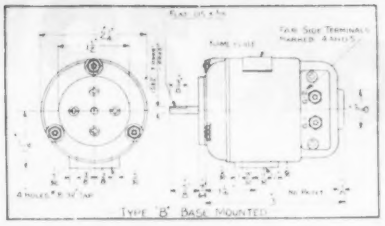
Radio and Electronics • Engineered Power Controls

NEW YORK • CHICAGO • KANSAS CITY • BURBANK

Electric Indicator Co.

has the *Knowledge,* the *Experience* and the *Facilities* to plan and produce the precision fractional horsepower motors and generators you need.

"ELINCO" A. C. INDUCTION



DRAG-CUP GENERATOR

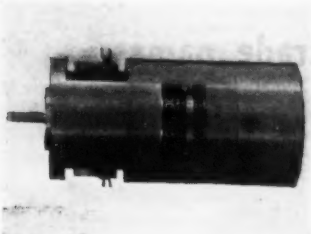
Both base and frame-mounted models; die-cast aluminum housing anodized and finished with baked black synthetic enamel. Consists of laminated stator wound two phase, stationary steel pole, and aluminum cup on shaft rotating between stator and pole. With voltage applied to one of the two stator phase terminals, rotation of shaft and cup induces voltage at other terminals lineal with speed.

Complete specifications upon request.

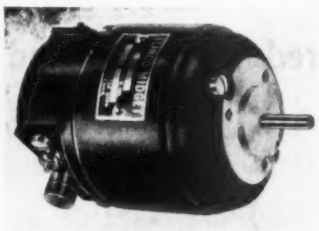
OTHER "ELINCO" MODELS

A wide variety of other special precision frac. h.p. motors and generators are available and described in our general catalog. Any of the finished or coated units can be treated to withstand tropical service in accordance with Signal Corps specification 71-2202A when specified.

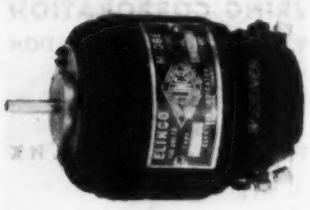
Type C: D.C. Generator. Permanent Magnet field, ball-bearing equipped. 1¾" outside diameter, 3⅝" in length. Weighs 16 ounces.



Type B: Permanent Magnet Field wound for one, two or three-phase A. C. Ball-bearing equipped; base mounted. 2¼" outside diameter—weighs 16 ounces.



Type M1: Indicating-type motor; also available in rotating and differential-type motors, and with double shaft.



ELECTRIC INDICATOR

CO.

115 PARKER AVE.

GLENBROOK

CONN.

DRAWN.....
DIE CAST....
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EXTRUDED...
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No one type of housing is suitable for all transformer applications. UTC units are housed in structures ranging from sand castings to bakelite cases made in thirty cavity molds. Illustrated from top to bottom...
Extruded cans typified by the now famous UTC Ouncer series... drawn round cans effect small base dimensions with screw mountings... die cast housings lend themselves to the construction of tunable inductors, etc.... drawn octagonal cans are simple in construction and effect a minimum of volume.

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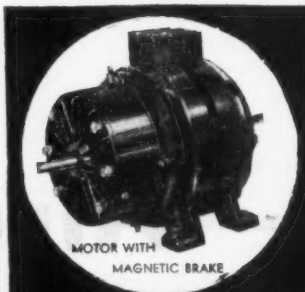
DROP-FORGINGS

ANY SHAPE • ANY MATERIAL • COMPLETE FACILITIES

Write for Free Forging Data Folder. Helpful, Informative

J. H. WILLIAMS & CO., *"The Drop-Forging People"* BUFFALO, N.Y.



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INDUSTRIAL
MARINE
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ELECTRONICS

A complete line of a.c., d.c., and Universal motors, d.c. and all Freq. a.c. generators, motor-generators, converters; dynamotors; gas & Diesel Elec. plants; explosion proof units; Machines designed for every purpose.

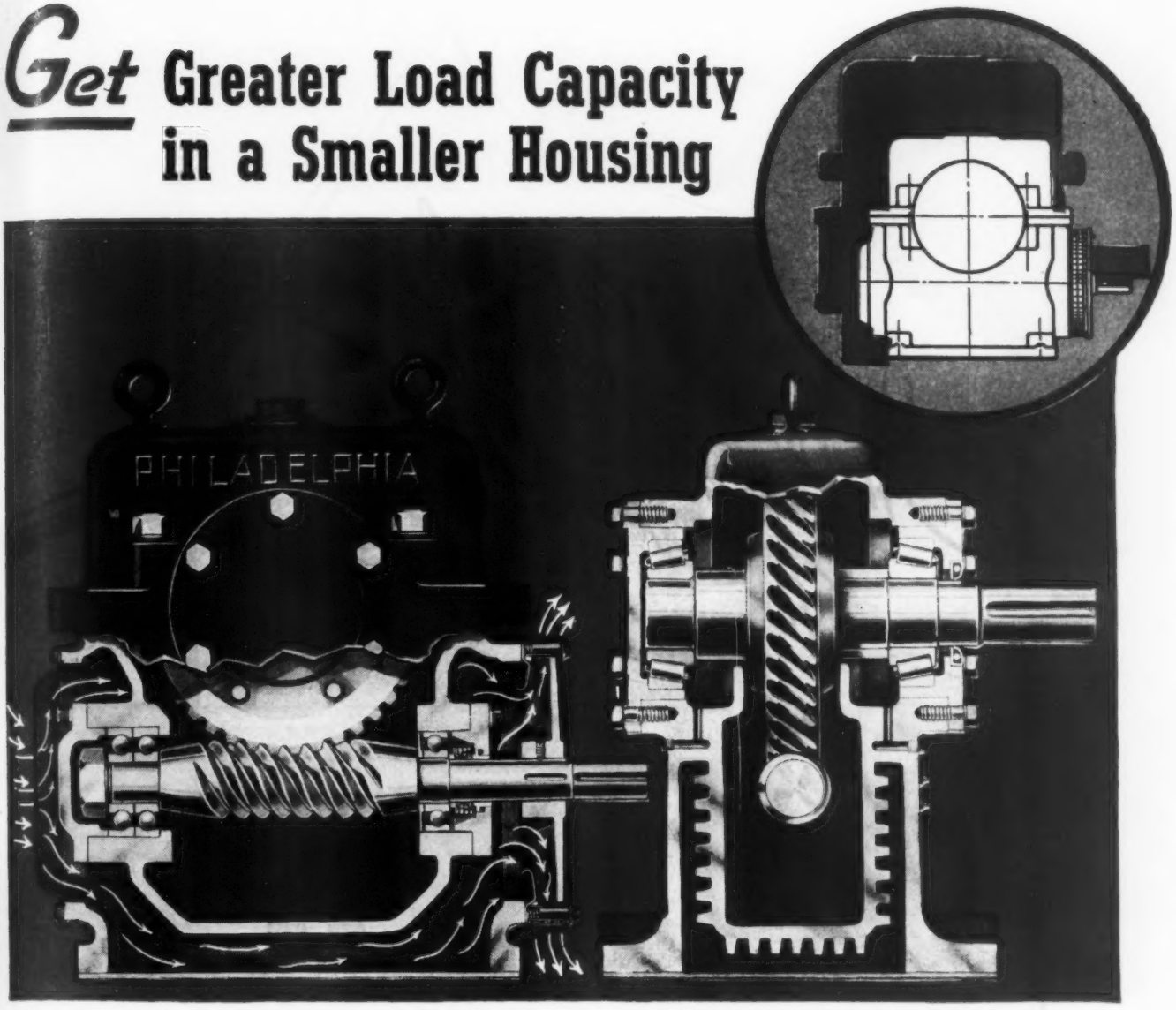
COMPLETE ENGINEERING SERVICE

Our engineers will be pleased to discuss your problems and aid in the design of machines to meet your requirements.

ELECTRIC SPECIALTY CO.

208 SOUTH ST. STAMFORD, CONN.

Get Greater Load Capacity in a Smaller Housing



...with the Philadelphia AIR KOOLED Worm Gear Speed Reducer

At the upper right is shown the comparative sizes of a size 675 Type AT standard unit (in blue) and a size 475 AirKooled unit. Both deliver 20 HP at 1750 RPM. Ratio 4 6/7 to 1.

The cut-away drawings show the double-walled, finned housing and the flow of air around the oil reservoir.

Considerable *space* and *weight* savings have been made possible by the design of Philadelphia AirKooled Worm Gear Reducers as compared with standard heavy duty type worm gear units.

The AirKooled design features a suction fan, mounted on the worm shaft, which draws air through the double-walled, finned housing. This dissipates generated heat, and thereby maintains a higher contact oil film strength and greatly increases the horsepower ratings at worm speeds of 580 and 1750 RPM. For all ratios at 1750 RPM the ratings are approximately doubled, so the AirKooled unit is about two sizes smaller than a standard unit of the same capacity.

Let us tell you what these savings can mean to you.

SEND FOR BULLETIN 250 .... *on your Business Letterhead*

ARMY E NAVY

Philadelphia GEAR WORKS INCORPORATED

ERIE AVE. AND G ST., PHILADELPHIA 34, PA. NEW YORK • PITTSBURGH • CHICAGO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

IMPERIAL PENCIL TRACING CLOTH

REG. U. S. PAT. OFF.

THIS has a uniform, reliable cloth base, combined with a special dull surface that has the property of making even a hard pencil produce lines that are both sharp and opaque.

Erasures are easily made, without damage. Excellent blue prints can be produced from it.

Also suitable for ink work.

Made by the manufacturers of the famous Imperial Tracing Cloth.

Sold by leading Stationery and Drawing-Material Dealers everywhere

SPECIAL

Gilmer BELTS

UNITED STATES RUBBER COMPANY · US · TRADE MARK

ANNOUNCEMENT

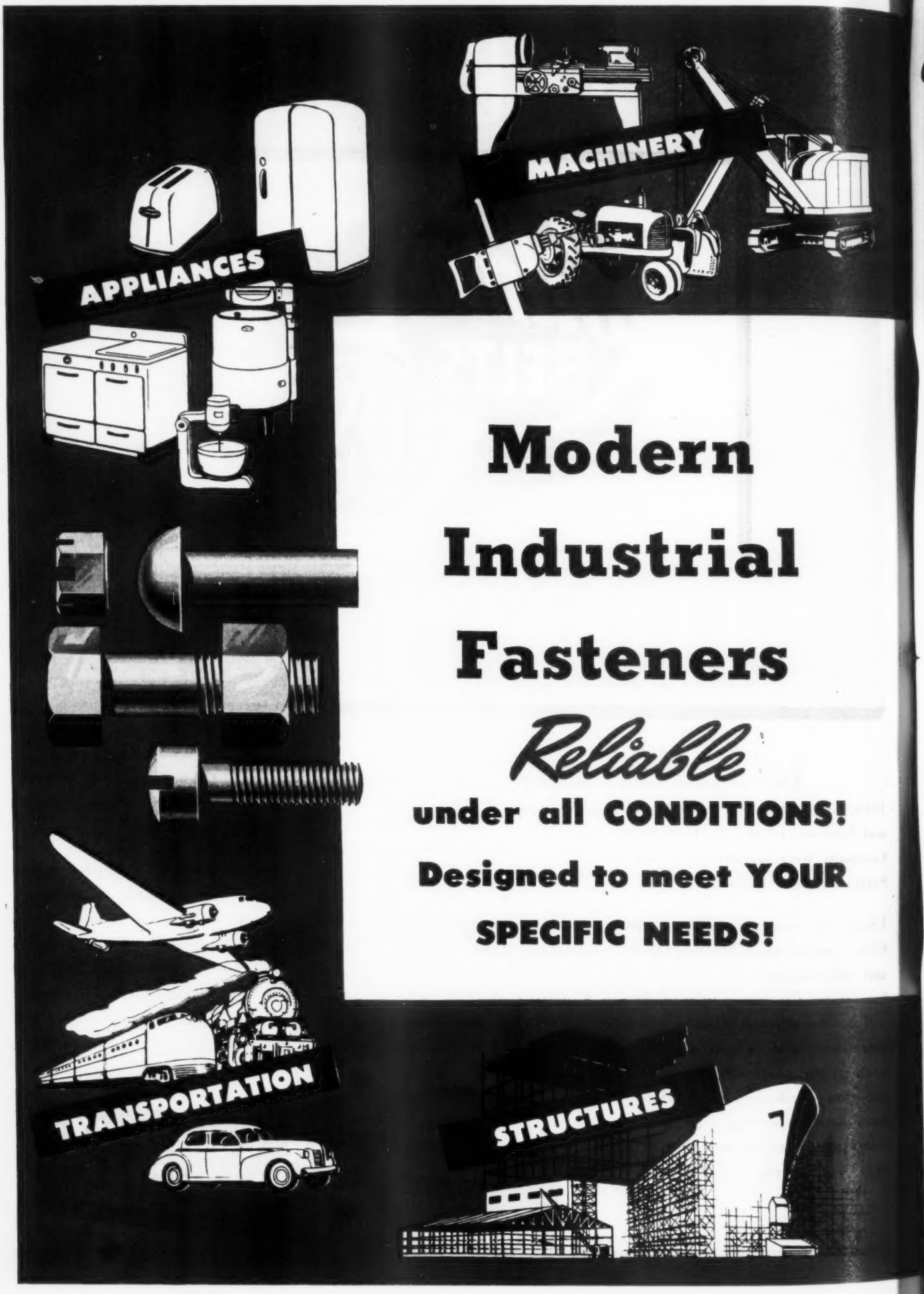
Effective November 30, 1944, the plant and property, assets and business of the L. H. Gilmer Company were acquired by United States Rubber Company.

Under the new arrangement, the Gilmer organization remains intact, and will continue to function as heretofore. Customer relationships will not be affected. Gilmer representatives, with whom you have dealt in the past, will continue to call upon you; department heads who have been answering your letters, telegrams and telephone calls will be here to serve you; and all the same fine, highly-specialized Gilmer Belts will be available.

The advantages of this change are many—to you and to the L. H. Gilmer Company. To our research and laboratory development there is now added the vast technical resources of United States Rubber Company. And the enlarged facilities of the Gilmer plant will enable us to render a more complete service. Today, Gilmer stands in a better position than ever before to supply your belting needs.

The L. H. Gilmer Company appreciates the patronage of its many friends, which has contributed much toward making the name Gilmer so well known and highly regarded throughout the world. It is hoped that this pleasant relationship will continue for many years to come.

L. H. GILMER COMPANY
Tacony, Philadelphia 35, Pa.
DIVISION OF UNITED STATES RUBBER COMPANY


APPLIANCES
MACHINERY
Modern
Industrial
Fasteners
Reliable
under all CONDITIONS!
Designed to meet YOUR
SPECIFIC NEEDS!
TRANSPORTATION
STRUCTURES

Special Qualities of Fasteners

that improve products and help fabrication

UNIFORMLY ACCURATE

Modern manufacturing methods as employed by fasteners makers, produce fasteners in large quantities having the degree of precision in dimensions required for fabrication of structures of all types. Whether your requirements are for extremely close tolerances for precision work, or high grade commercial quality, the products of up-to-date fasteners manufacturers today are uniform and dependable.

HIGH TENSILES

Carefully selected alloy steels properly heat treated are used by manufacturers to increase tensile strengths for application requiring this property.

CORROSION RESISTANCE

Fasteners are made from corrosion-resisting metals, or protected by coatings such as zinc plating, galvanizing, etc., wherever corrosion resistance is required.

HIGH FATIGUE STRENGTH

In dynamically stressed studs, high fatigue strength can be obtained by proper design without any weight increase.

FLUSH HEADS

Several types of countersunk, recessed, flat and other heads for bolts, cap screws and rivets are standard production with most manufacturers for use where required for surface smoothness or close fitting parts.

SPECIAL FINISHES

In addition to regular ground, machined or polished surfaces, you can get fasteners that are cadmium or chromium plated or otherwise specially finished for appearance, protection or other reasons.

DUCTILITY

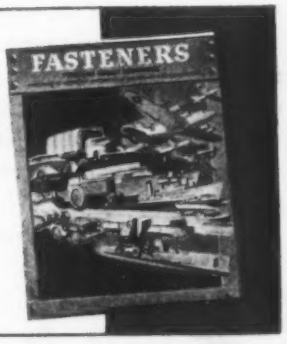
In many fastening jobs, a certain amount of ductility is desirable, and bolts or rivets providing that property can be obtained according to specification.

HARDNESS

This important and useful characteristic is readily obtainable in fasteners through modern hardening methods. The wide variety of materials from which fasteners are made permits a wide range of hardening.

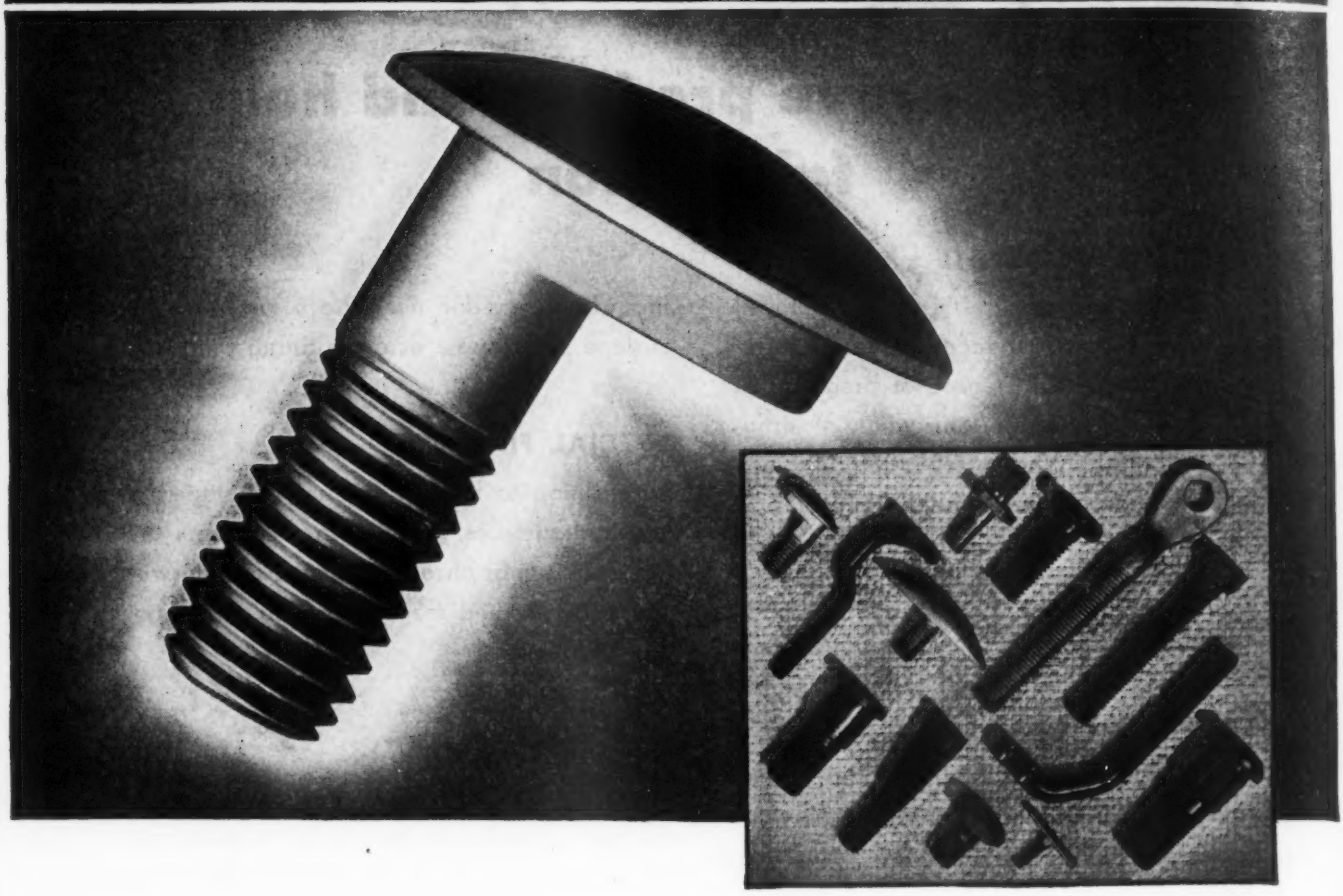
Useful Data

Let us put your name on the list to receive, regularly, issues of FASTENERS, containing interesting and useful data on the application of headed and threaded products.



AMERICAN INSTITUTE OF BOLT, NUT AND RIVET MANUFACTURERS
1550 Hanna Building · Cleveland 15, Ohio

100 YEARS *Making strong the things that make America strong*



How would you have it made...

for maximum strength? . . . for utmost accuracy? . . .
for best appearance? . . . for lowest cost? . . .

In every case, the answer would be "By COLD-FORGING"

Product strength is maximum because cold-working increases the tensile strength of the metal and also serves as an automatic inspection of the material.

Accuracy and appearance of the cold-forged product are superior. Modern cold-upsetting equipment provides the maximum in precision and fine finish. Billions of aircraft fastening parts have been made by this process.

Costs are held to a minimum, both by the high speed of the cold-forging equipment and by the saving in raw material through practically complete elimination of scrap.

When your planning calls for a product or part shaped like any of those at the right, consider cold-forging, which may be not only the *best*, but often the one efficient method of production. As soon as present wartime production requirements are fulfilled — RB&W will be able to give you the benefit of its high-production facilities and long experience — *longest experience in automatic cold-forging.*

RB&W

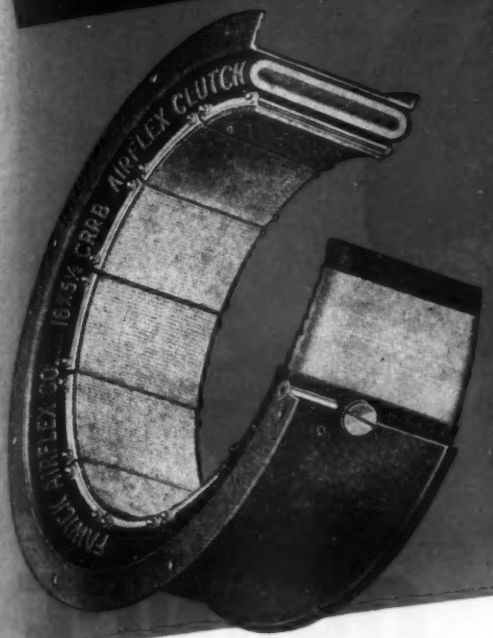
Russell, Burdsall & Ward Bolt and Nut Company . . . with factories at Port Chester, New York, Coraopolis, Pa., Rock Falls, Ill., . . . with sales offices at Philadelphia, Detroit, Chicago, Chattanooga, Los Angeles, Portland, Seattle . . . with the industry's most complete, easiest-to-use catalog.

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

JOBS WANTED !

by

HEAVY-DUTY CLUTCH WITH A WAR RECORD



To help ships maneuver faster than ever before —to help drags and shovels move earth by the million tons—to help heavy machines produce war implements 24 hours a day—those are the jobs on which the Fawick Airflex Clutch has earned its record.

Controlling power by air pressure, without levers or arms or springs, the Fawick Airflex Clutch needs no adjustments, no lubrication. It absorbs shocks and vibration and corrects for misalignment.

If you have a tough clutch or brake problem in any kind of heavy-duty service, write to our Engineering Department for information—they can help YOU.

for

DIESEL DRIVES
HEAVY MACHINES
DRAGS AND CRANES
PAPER MILLS
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OIL FIELD DRIVES
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* *

12 IMPORTANT OPERATING ADVANTAGES

1. Simple in design and operation
2. Flexible control by air
3. No adjustments or oiling—low maintenance
4. Dampens vibration—absorbs shocks
5. Corrects misalignment automatically
6. Smooth starting—no jerks
7. Quick stopping
8. Runs cooler—uniform pressure
9. Controls torque by air pressure
10. Greater capacity—more compact
11. Replaces couplings
12. Remote control by 4-way air valve

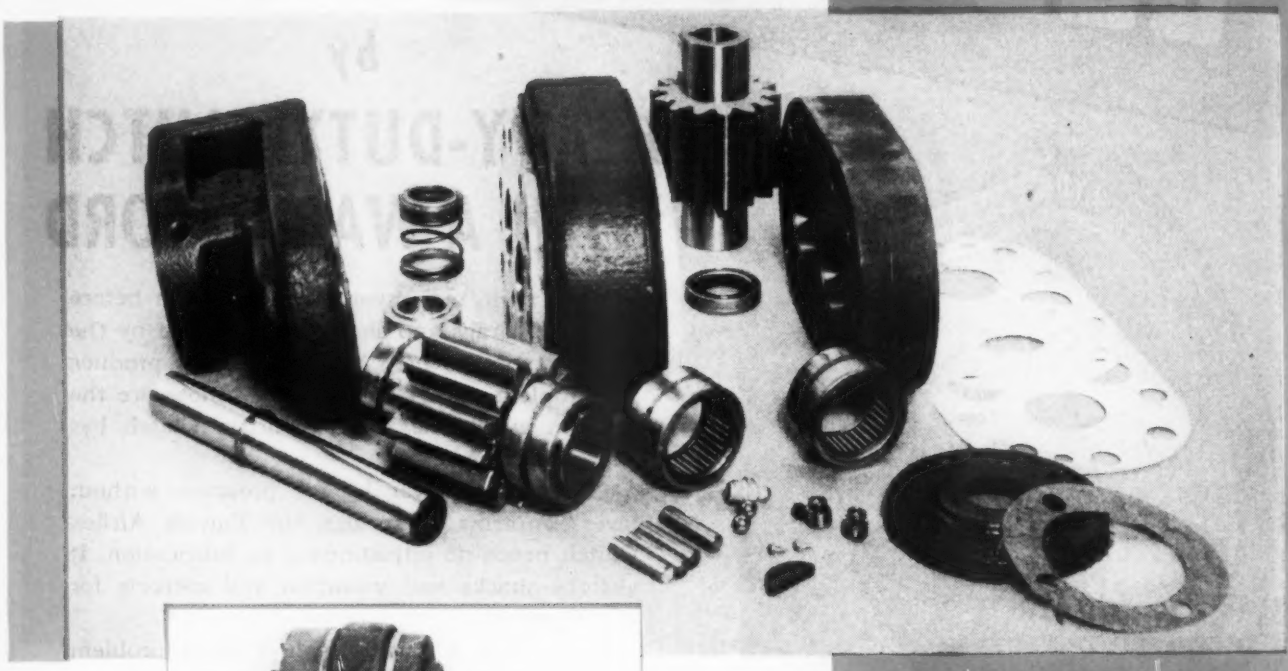
FAWICK AIRFLEX COMPANY, INC.
9919 Clinton Rd. Cleveland 11, Ohio
In Canada, **Renold-Coventry, Ltd., Montreal, Toronto, Vancouver**
In Britain, **Crofts Engineers, Ltd., Bradford, England**

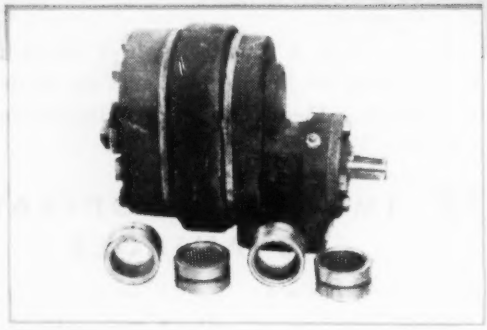
FAWICK *Airflex* CLUTCH

POWER CONTROLLED BY AIR

Easily Installed
IN COMPACT ASSEMBLIES!

This Gear Type Hydraulic Pump, made by the Commercial Shearing and Stamping Co., shows how the smooth-running protection of Orange Roller Bushings is obtained in a compactly designed product, where space is limited and operating requirements are severe.





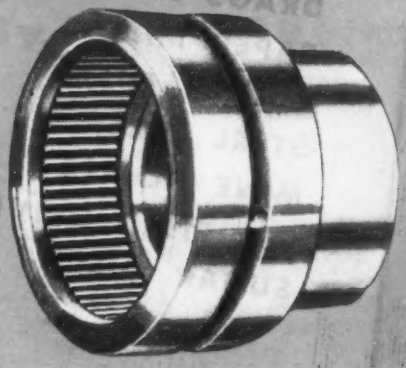
"Simplify it" . . . "make it more compact", are the never-ending goals of every design engineer. You'll find no more useful ally in this accomplishment, than Orange Roller Bushings.

The ability to carry heavy loads or to run at high speeds with very little space requirements, has enabled Orange Roller Bushings to help many an engineer out of "tight spots" in a compactly designed product.

Made to extreme standards of precision, Orange Roller Bushings have much closer running clearances—thus assuring true alignment of the rollers with the raceways. Smooth, long-life operation is assured. Send coupon for Engineering Data Book showing full range of types and sizes, capacities, installation data, etc. Consult our engineers on any bearing application.

ORANGE ROLLER BEARING CO., INC.
551 Main Street, Orange, N. J.

ORANGE
ROLLER BUSHINGS



Mail Coupon for Engineering Data

Orange Roller Bearing Co., Inc., P. E.
Orange, N. J.

Please send me your Roller Bushing Data Book

Name ..... Title .....

Company .....

Address .....

City ..... State .....

Quality...

HEADACHE PREVENTIVE

Take any seamless steel tubing application—whether it be a machine tool part, or a part turned out by that machine tool . . . If the tubing used has been checked for quality in every step of its production, you know that the required, specified properties have been delivered. Many of your production, spoilage headaches are forestalled.

At OSTUCO, every step of the tube-making process has its quality-maintaining checks. Each is constantly reviewed and refined even though it may have been a routine operation for years. What's more, some of those quality-building steps are performed by men who have been tube-makers ever since the first steel billet was pierced in America.

If your plans call for replacement of war-worn machinery — or new products — you'll find OSTUCO's quality tubing offers the production efficiency you're looking for in the manufacture of precision parts for machine tools, automotive and aircraft and other applications in the metal-working field. For sales and engineering service in the reconstruction period ahead, call on the OSTUCO sales office nearest you:

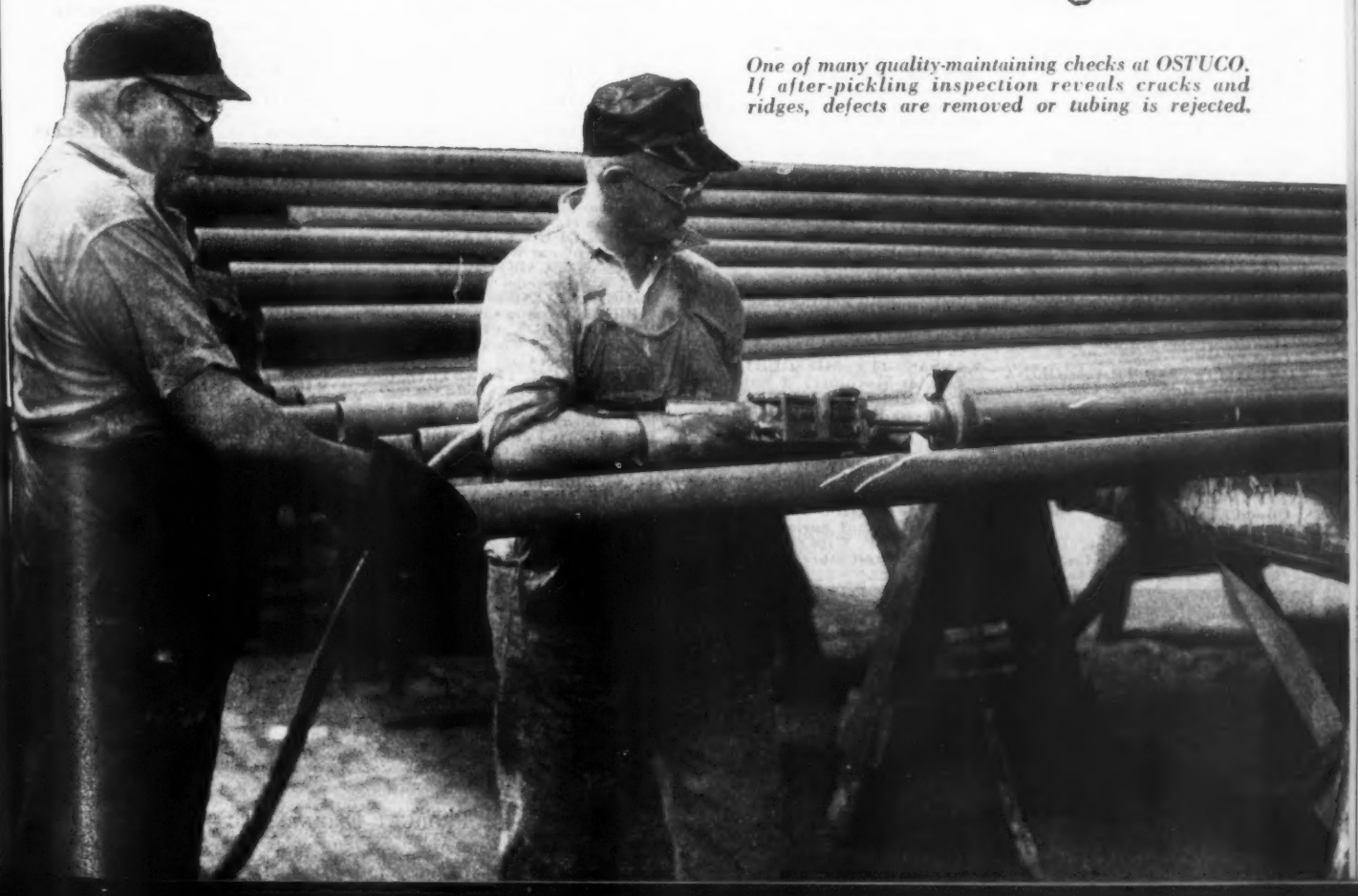
CHICAGO 6, ILLINOIS	Civic Opera Bldg., 20 N. Wacker Drive
CLEVELAND 14, OHIO	1328 Citizens' Bldg.
DETROIT 2, MICHIGAN	2857 E. Grand Blvd.
HOUSTON, TEXAS	1006 Washington
LOS ANGELES, CALIF.	Suite 200-170 So. Beverly Drive Beverly Hills, California
MINNEAPOLIS 2, MINN.	402 Thorpe Bldg.
MOLINE, ILLINOIS	225 Fifth Ave. Bldg.
MONTREAL, QUEBEC, CANADA	3735-3745 St. James St.
NEW YORK CITY 17, N. Y.	70 East 45th St.
PHILADELPHIA 9, PA.	123 S. Broad St.
SYRACUSE, N. Y.	501 Roberts Ave.
TORONTO, ONT., CANADA	77-79 Front St. E.
TULSA 3, OKLAHOMA	604 Tulsa Loan Bldg.
VANCOUVER, B. C., CANADA	1016 Mainland St.

THE OHIO SEAMLESS TUBE COMPANY

Plant and Main Office—SHELBY, OHIO

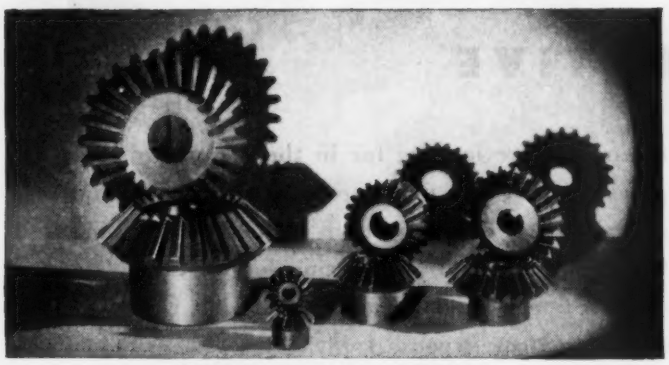
MANUFACTURERS OF SEAMLESS AND ELECTRIC-WELD STEEL TUBING

SHELBY OSTUCO OHIO

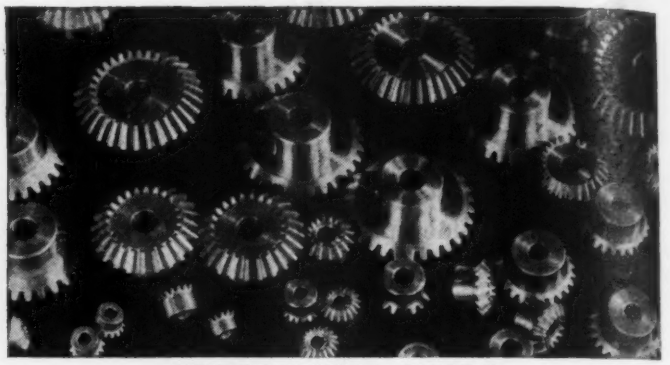


One of many quality-maintaining checks at OSTUCO. If after-pickling inspection reveals cracks and ridges, defects are removed or tubing is rejected.

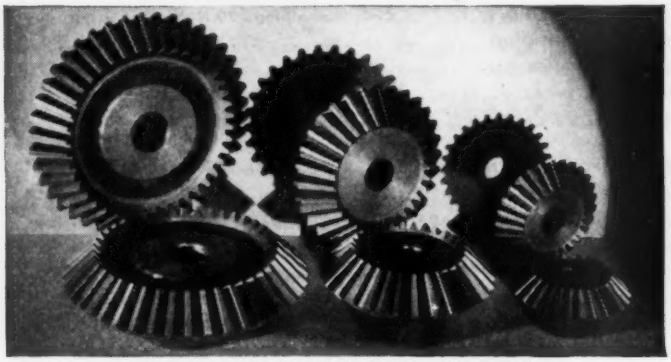
MITER GEARS



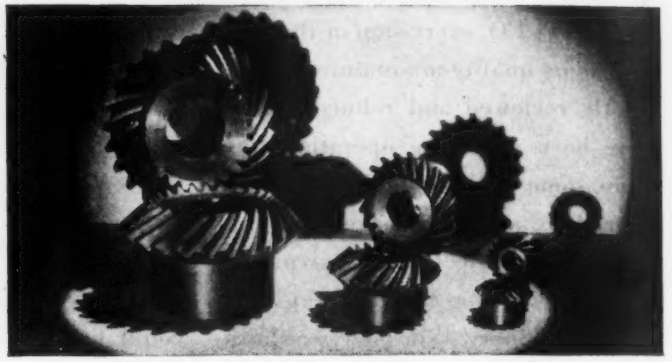
STEEL MITER GEARS



BRASS MITER GEARS



CAST IRON MITER GEARS



STEEL SPIRAL MITER GEARS

Many sizes of Boston Gear Standard miter gears are IN STOCK READY FOR YOUR IMMEDIATE USE. Boston Gear Standard sizes comprise the following: steel miter gears in pitch diameters from 3/8" to 6", brass miter gears in pitch diameters from 5/16" to 1½", cast iron miter gears in pitch diameters from 3½" to 14", and steel spiral miter gears in pitch diameters from 1" to 5". Any of the following authorized distributors and direct company branches will be pleased to give you complete specifications and prices of these products.

AKRON, OHIO
Manufacturers Rubber & Supply Company
ALBANY, NEW YORK
Sager-Spuck Supply Co., Inc.
ALLENTOWN, PENNSYLVANIA
Wm. H. Taylor & Co., Inc.
ATLANTA, GEORGIA
J. M. Tull Metal & Supply Co.
BALTIMORE, MARYLAND
Carey Machinery & Supply Co.
BOSTON, MASSACHUSETTS
Boston Gear Works, Inc.
Chandler & Farquhar Co., Inc.
BRIDGEPORT, CONNECTICUT
Hawley Hardware Co.
BROOKLYN, NEW YORK
H. L. Dickie
BUFFALO, NEW YORK
Root, Neal & Co.
BURLINGTON, NORTH CAROLINA
Kester Machinery Co.
CANTON, OHIO
Manufacturers Rubber & Supply Company
CHARLOTTE, NORTH CAROLINA
Mathews-Morse Sales Co.
CHICAGO, ILLINOIS
Berry Bearing Co.
Boston Gear Works, Inc.
Chicago Pulley & Shafting Co.
Power Transmission Equipment Company
CINCINNATI, OHIO
Queen City Supply Co.
CLEVELAND, OHIO
Boston Gear Works, Inc.
Mau-Sherwood Supply Co.
DALLAS, TEXAS
Geo. J. Fix Co.
DAVENPORT, IOWA
Standard Bearings Co.
DAYTON, OHIO
Klinger-Dills Co.
DENVER, COLORADO
Denver Equipment Co.
Western Belting & Packing Co.
DES MOINES, IOWA
Standard Bearings Co.
DETROIT, MICHIGAN
Chas. A. Strelinger Co.
EVANSVILLE, INDIANA
Bearings Service Co., Inc.
HARTFORD, CONNECTICUT
Silliter-Holden, Inc.
HIGH POINT, NORTH CAROLINA
Kester Machinery Co.
INDIANAPOLIS, INDIANA
Indianapolis Belting & Supply Co.
Vonnegut Hardware Co.
JACKSONVILLE, FLORIDA
S. B. Hubbard Co.
KANSAS CITY, MISSOURI
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NASHVILLE, TENNESSEE
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NEW ORLEANS, LOUISIANA
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L. C. Biglow & Co., Inc.
Boston Gear Works, Inc.
Bronx Hardware & Supply Co.
NORTH QUINCY, MASS.
Boston Gear Works, Inc.
OAKLAND, CALIFORNIA
C. W. Marwedel
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Illinois Bearing Co.
PHILADELPHIA, PENNSYLVANIA
Boston Gear Works, Inc.
Maddock & Co.
PITTSBURGH, PENNSYLVANIA
Somers, Fitler & Todd Co.
PORTLAND, OREGON
Woodbury & Co.
PROVIDENCE, RHODE ISLAND
Machine Parts Corp.
RICHMOND, VIRGINIA
Apex Machine Mfg. Co.
ROCHESTER, NEW YORK
John M. Forster Co.
ST. LOUIS, MISSOURI
Colcord-Wright Machinery & Supply Co.
ST. PAUL, MINNESOTA
R. C. Duncan Co.
SAN FRANCISCO, CALIFORNIA
C. W. Marwedel
SEATTLE, WASHINGTON
Cragin & Co.
SIOUX CITY, IOWA
Standard Bearings Co.
SOUTH BEND, INDIANA
Bearings Service Co., Inc.
SPRINGFIELD, MASSACHUSETTS
Boston Gear Works, Inc.
Stacy Supply Co.
SYRACUSE, NEW YORK
Syracuse Supply Co.
TAMPA, FLORIDA
Lenfestey Supply Co.
TOLEDO, OHIO
The Ohio Belting & Transmission Company
TRENTON, NEW JERSEY
Wiley-Hughes Supply Co.
UTICA, NEW YORK
Boston Gear Works, Inc.
WATERBURY, CONNECTICUT
White Supply Co.
WINSTON-SALEM, N. CAROLINA
Kester Machinery Co.
WORCESTER, MASSACHUSETTS
W. M. Steele Co.

★ ★ ★

CANADA, MONTREAL
Renold Coventry, Ltd.
CANADA, TORONTO
Renold Coventry, Ltd.
CANADA, VANCOUVER
Renold Coventry, Ltd.

BOSTON GEARS

Kidde total-flooding system smothers fire in flammable liquid storage room in less than twenty seconds.

BEFORE TOUGH FIRES GET TOO TOUGH

. . . *blast them out with Kidde!*

KIDDE KILLS TOUGH FIRES

In fighting the tough fires—the fast-moving ones that break out in flammable liquids (class B); and the hard-to-get-at types that start in electrical installations (class C)—you've got to smother them fast or they'll spread beyond control in a few minutes.

Ordinary water-type extinguishers can't control these tough fires. But built-in Kidde systems, employing carbon dioxide, will smother them in a matter of seconds. That is why Underwriters' and Factory Mutual Laboratories approve Kidde for fighting *both* these types of fire.

Some of the Kidde built-in systems are so designed that the fire can be automatically isolated, and the room quickly filled with flame-suffocating carbon dioxide. This gas—being dry, inert, odorless and non-toxic—leaves no after-fire mess to be cleaned up, cannot damage any materials; and does not contaminate or otherwise spoil costly processes. In brief, Kidde is one of the speediest, cleanest and most effective fire extinguishers in use today.

So, check this list (at right) now. Does even *one* of these hazards exist in your plant? If it does, write Kidde today. Ask to have a Kidde representative call upon you. He'll be glad to share his fire-prevention know-how with you.

K Kidde

Process Rooms
Ovens
Spreaders
Motors
Storage Rooms
Mixers
Coaters
Transformers
Dip Tanks
Agitators
Washers
Quench Tanks

Walter Kidde & Company, Inc. • 140 Cedar Street • New York 6, N. Y.

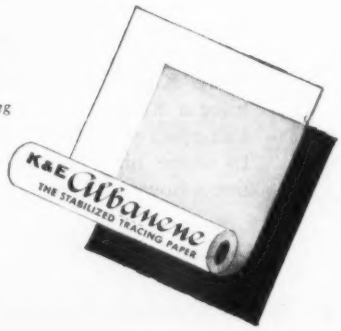
Still Young at 99..

Who wants a tracing paper that's still good—and we mean *good*—still white, transparent, flexible—99 years later? Well, you can never tell. Maybe more tragic things have happened than having a drawing go to ruin in its sleep, but nevertheless, that can be awfully serious. That's only one reason why we developed ALBANENE white tracing paper. It's permanent, because it's made of 100% long-fibre pure white rags, treated with Albanite. In drafting rooms today there are drawings on ALBANENE that are years old and still in perfect condition.

What's Albanite? It's a crystal-clear, unaltering synthetic developed by the K&E Laboratories, and is simply tops as an impregnating medium for long-fibre paper stock. That gives ALBANENE extra transparency. And because ALBANENE stays white, it gives strong, contrasting prints. It's fine to work on too, with pencil or ink—keeps clean and takes erasures well. That's not the whole story; to get it all, write us on your letterhead for a sample sheet. Made in rolls, sheets, and pads.

K&E

Drafting, Reproduction, Surveying Equipment and Materials Side Rules, Measuring Tapes



Albanene

REG. U. S. PAT. OFF.

KEUFFEL & ESSER CO.

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NEW YORK • HOBOKEN, N. J.

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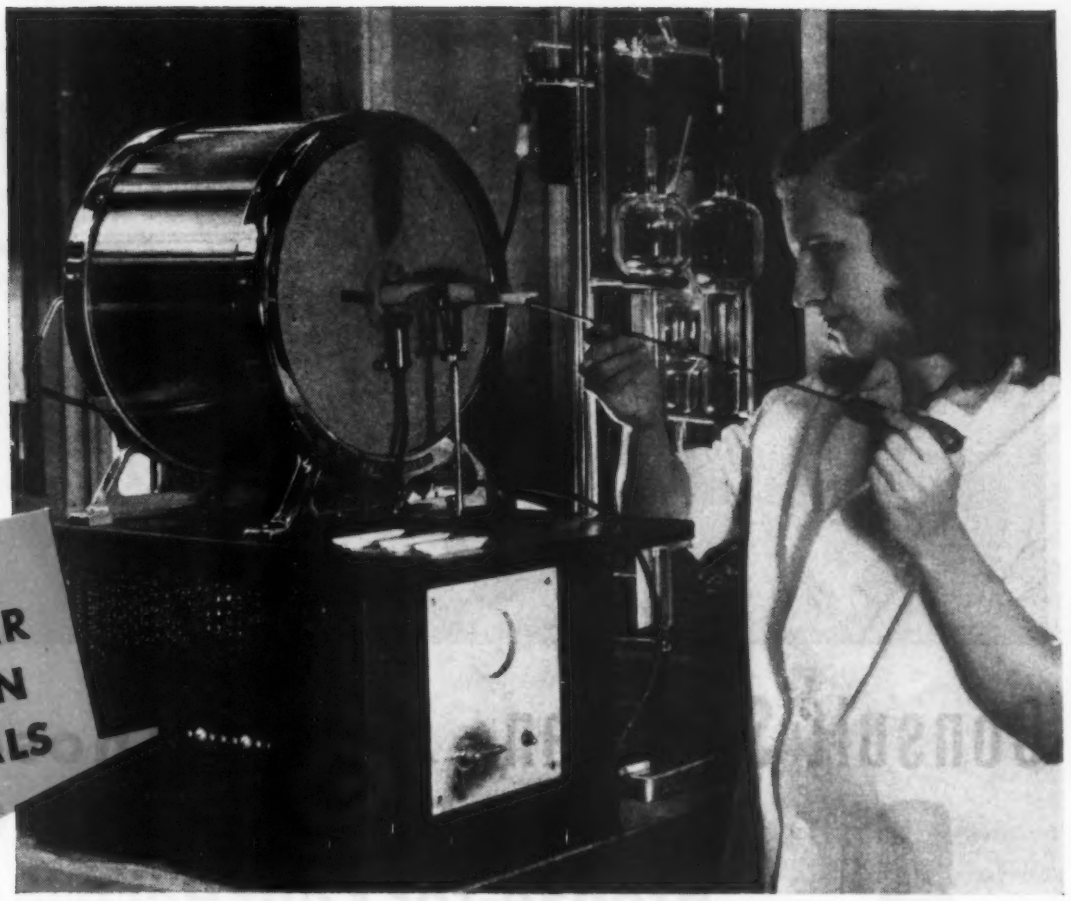


...are being perfected NOW!

MEASURING the exact amount of carbon in each Velvetouch formula, as shown in the photograph above, is only one of many controls by which we assure uniformity of quality. Our laboratories are engaged in never-ending research to improve still further the friction qualities of Velvetouch *all-metal* clutch facings and brake linings . . . so that you may safely specify Velvetouch for rugged, heavy-duty operating conditions in all types of industrial machinery.

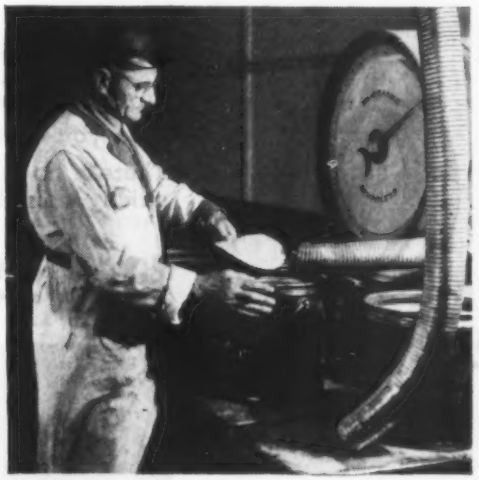
THE S. K. WELLMAN COMPANY

1374 EAST 51st STREET • • CLEVELAND 3, OHIO

Velvetouch is *all metal* —a combination of powdered metals, compressed, sintered and welded to a solid steel backing.

For Brake and Clutch . . . Use Velvetouch

The "INSIDE STORY" of POWDER METALLURGY



CHAPTER 1. Powdered metals—iron, lead, tin, etc.—first are carefully blended in the right proportions for each type of brake and clutch. After thorough mixing, they are ready for the molding and sintering operations. . .

Consult Sherman—About Those Drawn Tubular Parts of Brass, Copper or Bronze-*for Your Postwar Products*

Hose Couplings
A full line of brass couplings for hose up to 6".

Brass Clamps
A full line of clamps for Oil, Steam, Air and Water Hose.

•

Electrical Terminals, Soldering Lugs, Fuse Clips and numerous other electrical specialties. Many items CARRIED IN STOCK.

In our plant you'll find the modern facilities, the trained personnel, and the experienced engineering staff required for volume production of those drawn tubular parts that you require.

We specialize in deep drawing tubular parts like those shown above from sheet metal—brass, bronze, or copper. With over 140,000 square feet of manufacturing floor space—with over 400 skilled employees—with modern production facilities and an experienced engineering staff, we have the capacity to turn out from three million to five million drawn pieces per month.

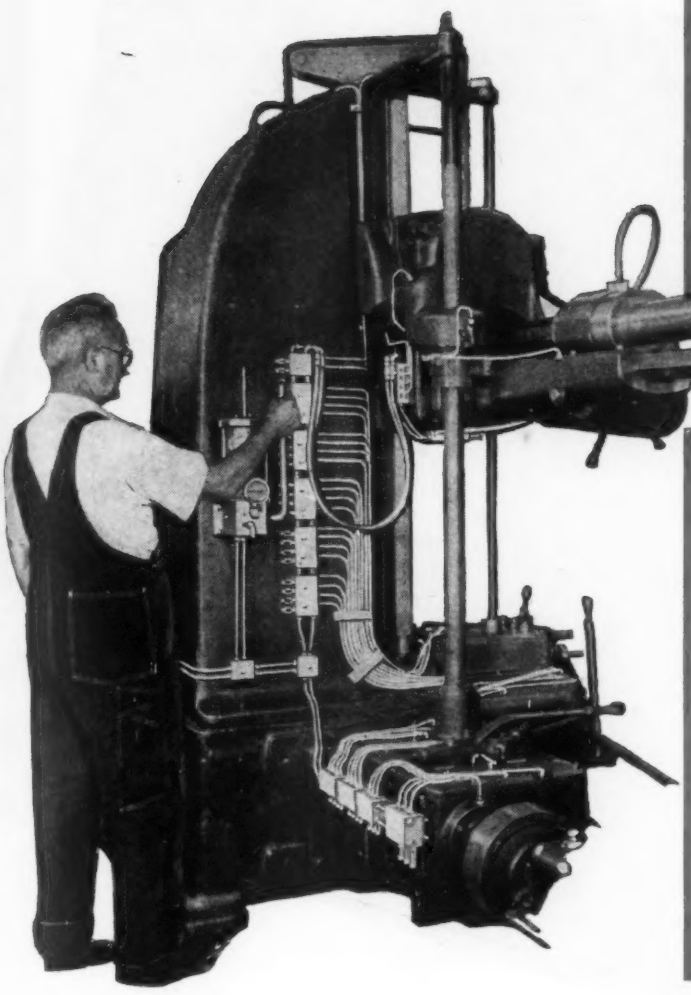
We have a completely equipped die department, with ample facilities for tooling, to manufacture your parts on our special machinery. We are also equipped to do some secondary machining and assembly work on parts which we manufacture.

Our engineers may be able to give you valuable suggestions for improved design and economical production of drawn parts that you will require. Send us a sketch of these parts, so that we can prepare our recommendations and give you an estimate of price and cost of tooling.

There's no obligation involved, and all data submitted by you will be kept strictly confidential. May we hear from you?

H. B. Sherman Mfg. Co.

24 BARNEY STREET
Battle Creek, Mich.



HOW TO LUBRICATE ALL OF YOUR BEARINGS

at once

with machines in full operation

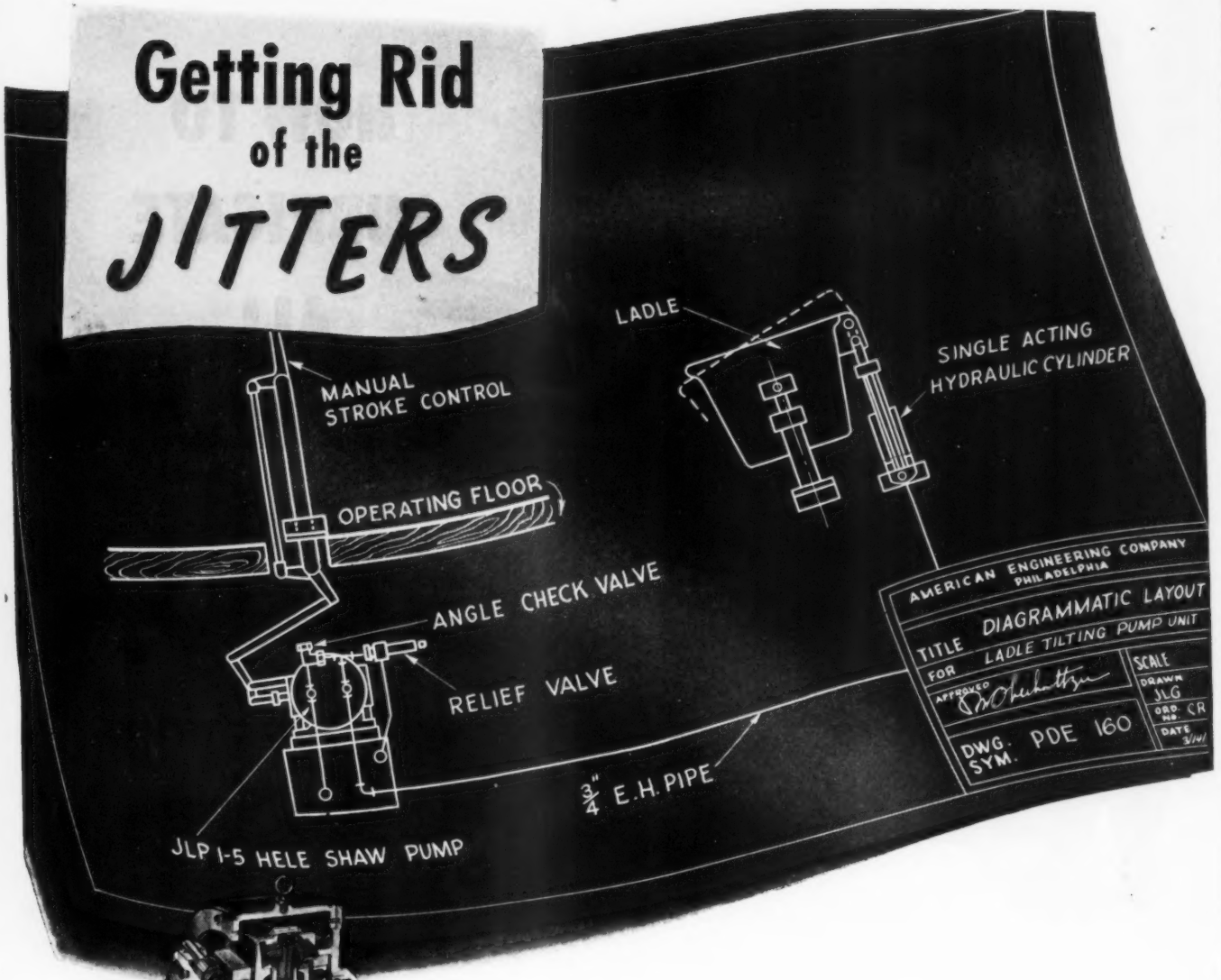
THE Farval Centralized System of Lubrication puts your machines on a non-stop schedule: brings production up to high-profit levels and *keeps* it there. Farval lubricates every single bearing, no matter where it is, with the equipment running at full speed.

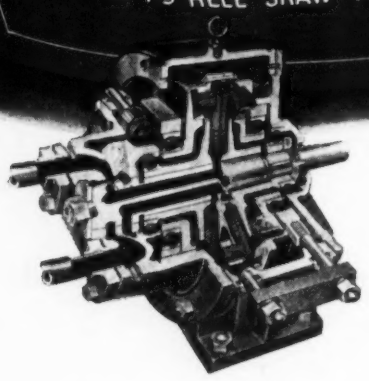
Your machines produce *more,* earn *faster*—because Farval eliminates the down time required to lubricate by hand or to repair the lack of lubrication. Bearings last 5 to 25 times longer—consumption of lubricant is cut by 75%. *Farval savings add up fast!*

Many of your customers know Farval by experience and will appreciate your installing Farval Systems on the equipment they buy. We will be glad to help you select the correct type of System for your machines. The Farval Corporation, 3279 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing
In Canada: PEACOCK BROTHERS LIMITED

Getting Rid of the JITTERS





THE HELE-SHAW

Fluid Power

PUMP

OTHER Æ PRODUCTS:

TAYLOR STOKERS, MARINE DECK AUXILIARIES

LO-HED HOISTS, DIAMOND FACE GRINDERS

A "Red Hot" Problem Solved by Hele-Shaw Fluid Power

Red hot metal poured from the ladle to the molds below. But it had the "jitters" . . . which of course caused trouble resulting in excessive rejects. The electrical tilting device was jerking and jarring the ladle and shimmying the flow of metal.

The remedy for this troublesome condition turned out to be Hele-Shaw Fluid Power (oil under pressure). A hydraulic lifting cylinder was hooked up to a special hand-lever controlled reversible Hele-Shaw Pump . . . and from then on pouring was smooth as a cat's purr.

Hele-Shaw Fluid Power provides safer, smoother operation in countless hydraulic applications. Go hydraulic with Hele-Shaw Pump, the power generator of the future, available to *you* today. Let us point out specific advantages for *your* needs.

AMERICAN ENGINEERING COMPANY

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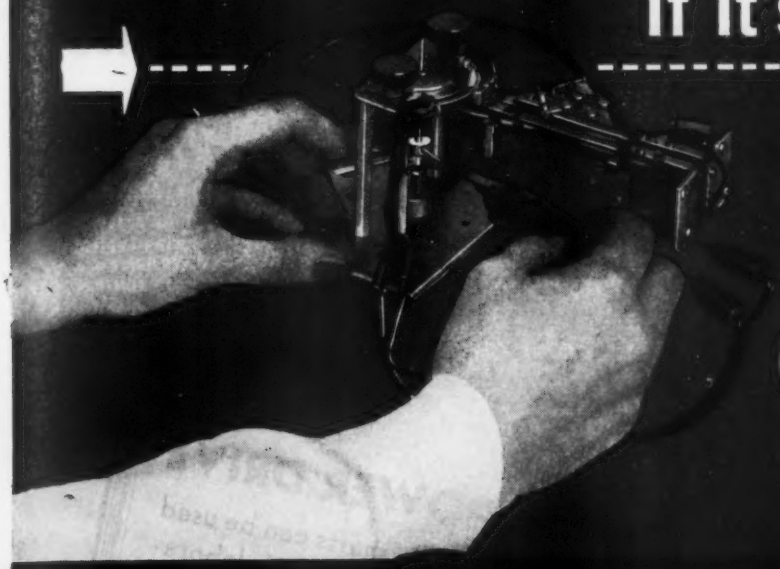
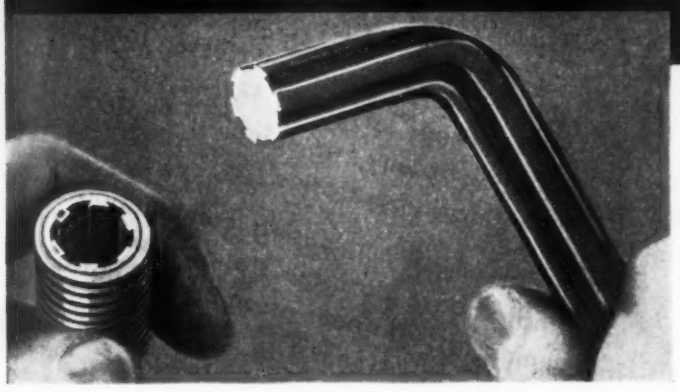
If It's Hard To Get At



it's Easy with...

THE SCREW THAT'S GEARED TO THE KEY



EASIER, FASTER ASSEMBLIES . . . greater holding power . . . convenient disassembly . . . are the reasons why Bristo Multiple-Spline Socket Set Screws are being used in tremendous quantities now that it is so important to specify the best. To accommodate greatly enlarged demand, manufacturing facilities have again been increased — this time by 25% — and further expansion is being planned.

THE TIGHTEST-SETTING SMALL SCREW ON THE MARKET

When the fastening point is awkwardly located or so small that it's hard to get at . . . or where vibration will be encountered . . . plan on using Bristo Screws.

The unique multiple spline design *gears* the screw to the key — for convenience in handling . . . and to utilize greater wrenching force without damage. The Bristo screw can be turned far beyond the point where an ordinary screw would burst or at least round out. Sizes as small as No. 4 wire can be set to withstand real vibration. Yet if adjustments need to be made, a flick of the key will loosen the screw.

Specified by leading aircraft and communications equipment manufacturers; ideal for electrical appliances, cameras, motor assemblies, instruments, etc. See other applications listed in THOMAS' REGISTER.

WHY "BRISTO" MEANS "TIGHTER"

Bristo: No expanding pressure; the key pulls the screw around.

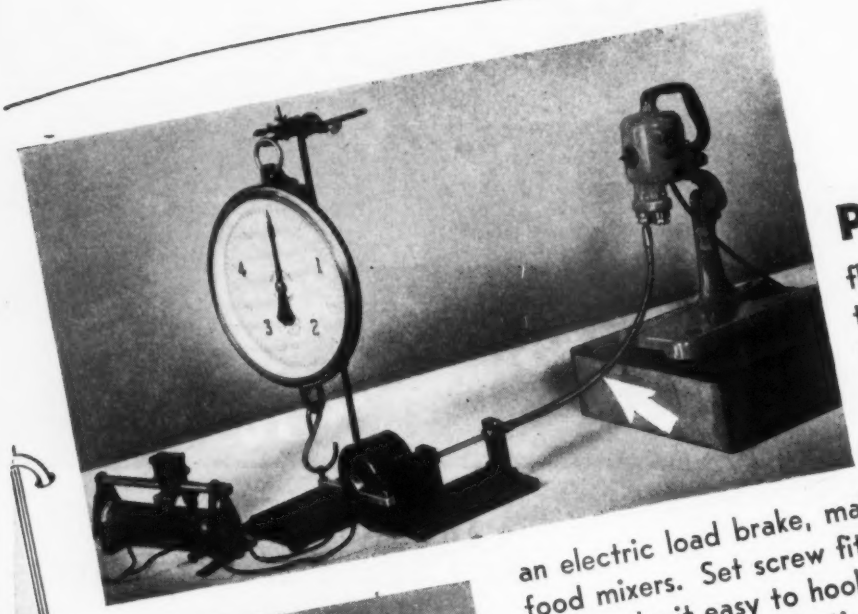
BRISTO MULTIPLE-SPLINE SOCKET SET SCREWS

GEARED TO THE KEY — FOR FASTER, EASIER, TIGHTER SETTING

The BRISTOL Company
MILL SUPPLY DIVISION

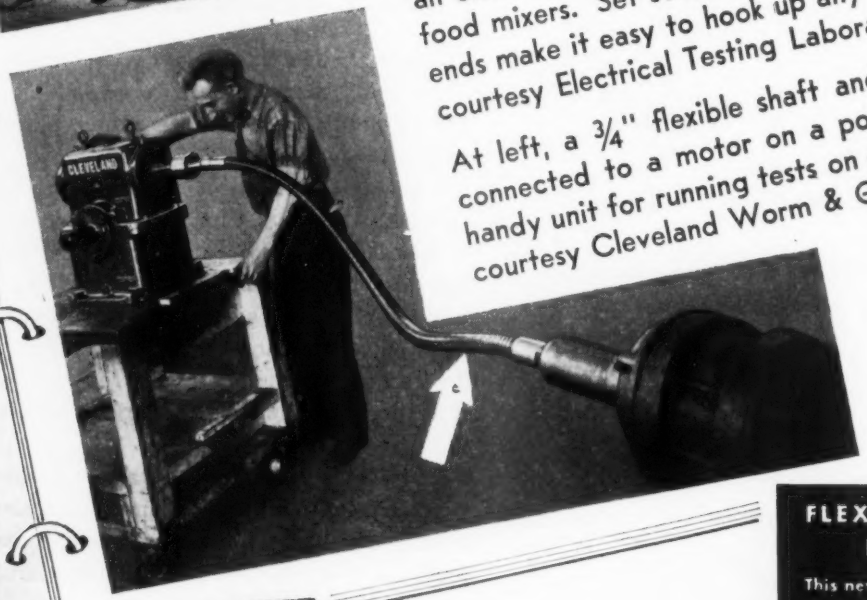
Ideas FOR DESIGN-ENGINEERS—IN THESE USES OF *S.S.White Flexible Shafts*

ONE OF A SERIES showing typical POWER DRIVE and REMOTE CONTROL applications



POWER DRIVE

flexible shafts can be used to advantage in laboratory and inspection department testing equipment. Above, a 3/8" flexible shaft connected to an electric load brake, makes a convenient tester for food mixers. Set screw fittings, attached to the shaft ends make it easy to hook up any two spindles. Photo courtesy Electrical Testing Laboratories.



At left, a 3/4" flexible shaft and casing combination connected to a motor on a portable stand, makes a handy unit for running tests on gear assemblies. Photo courtesy Cleveland Worm & Gear Co.

FLEXIBLE SHAFT HANDBOOK FREE TO ENGINEERS

This newly published 256-page handbook gives complete information and engineering data on both power drive and remote control flexible shafts and how to apply them. A copy, free to any engineer who complies with this provision — make your request on your business letterhead and indicate your position.

ARMY E NAVY

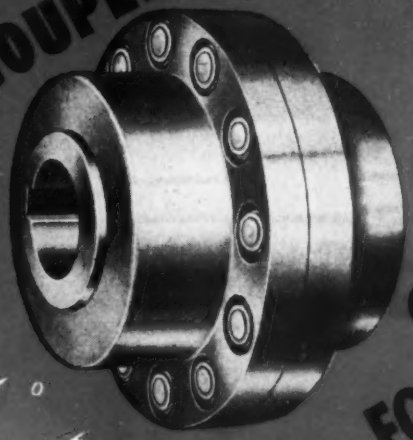
S.S.WHITE INDUSTRIAL DIVISION

THE S. S. WHITE DENTAL MFG. CO. DEPT. D 10 EAST 40th ST., NEW YORK 16, N. Y.

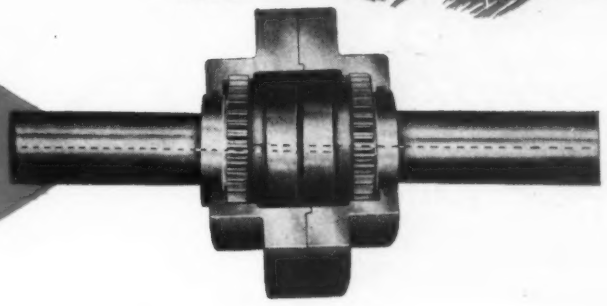
FLEXIBLE SHAFTS AIRCRAFT ACCESSORIES
MOLDED PLASTICS
MOLDED RESISTORS FLEXIBLE SHAFT TOOLS

One of America's AAAA Industrial Enterprises

Here's how FARREL GEARFLEX COUPLINGS COMPENSATE FOR MISALIGNMENT

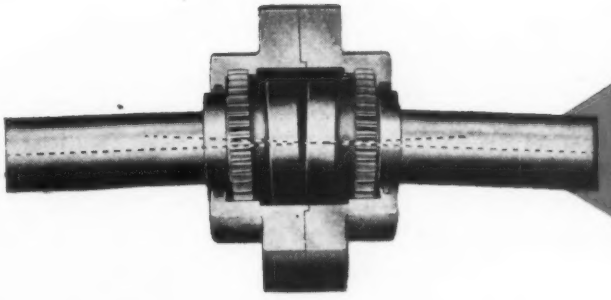


OFFSET MISALIGNMENT



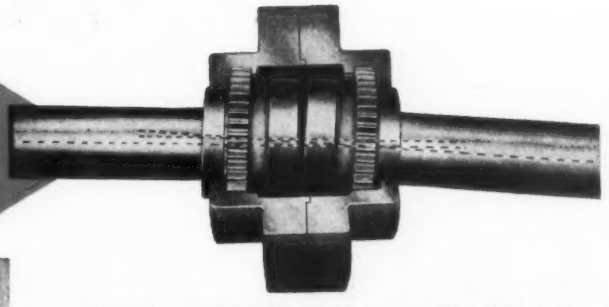
The floating sleeve of this coupling adjusts itself to the amount of misalignment, without producing artificial loadings. When the two shafts are offset but still parallel, the floating sleeve will be at an angle, with respect to a plane common to the two shafts, sufficient to allow for this variation.

When shafts are in line but at an angle to each other, the hub faces will be at the same angle. The hub teeth move toward the ends of the teeth of the floating sleeve, each mating pair of external and internal gears assuming an equally divided proportion of the misalignment.



ANGULAR MISALIGNMENT

COMBINATION MISALIGNMENT



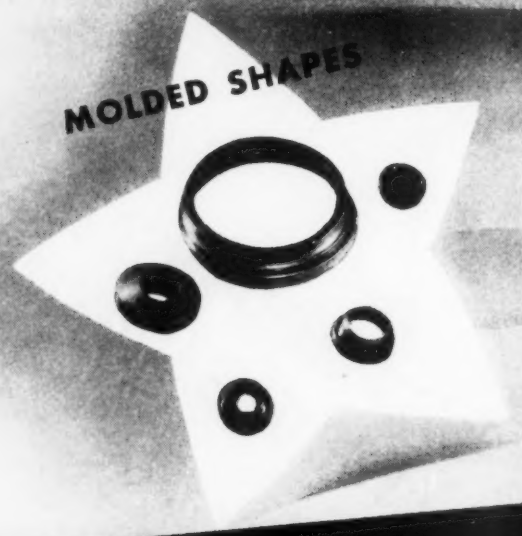
When shafts are not in line, nor parallel, the hub faces are at an angle to each other and the floating sleeve assumes a position of angularity to compensate for the position of the hubs. End float is always free.

Farrel Gearflex Couplings are available in a complete range of sizes for shaft diameters up to 21 inches. Write for detailed information. Ask for a copy of Catalog No. 443.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONN. BUFFALO, N. Y.
Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Los Angeles, Tulsa, Houston

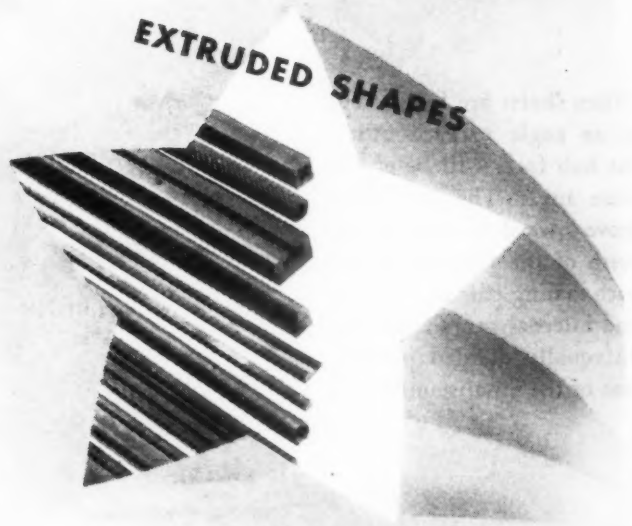
Farrel-Birmingham

Stars on the Postwar Stage–



TO PERFORM FOR *Your Products*

ACADIA SYNTHETIC PRODUCTS



From their performance in wartime goods, Acadia Synthetic Products have assured themselves a place in products of peace.

Processing synthetic rubber to give it form, Acadia Synthetic Products molds, extrudes and cuts it to exacting tolerances to meet your requirements.

Acadia Engineers are prepared to help you obtain the characteristic or combination of characteristics you require. Feel free to call upon them at any time with any problem involving the possible use of Acadia Synthetics.

ACADIA *Synthetic* **PRODUCTS**

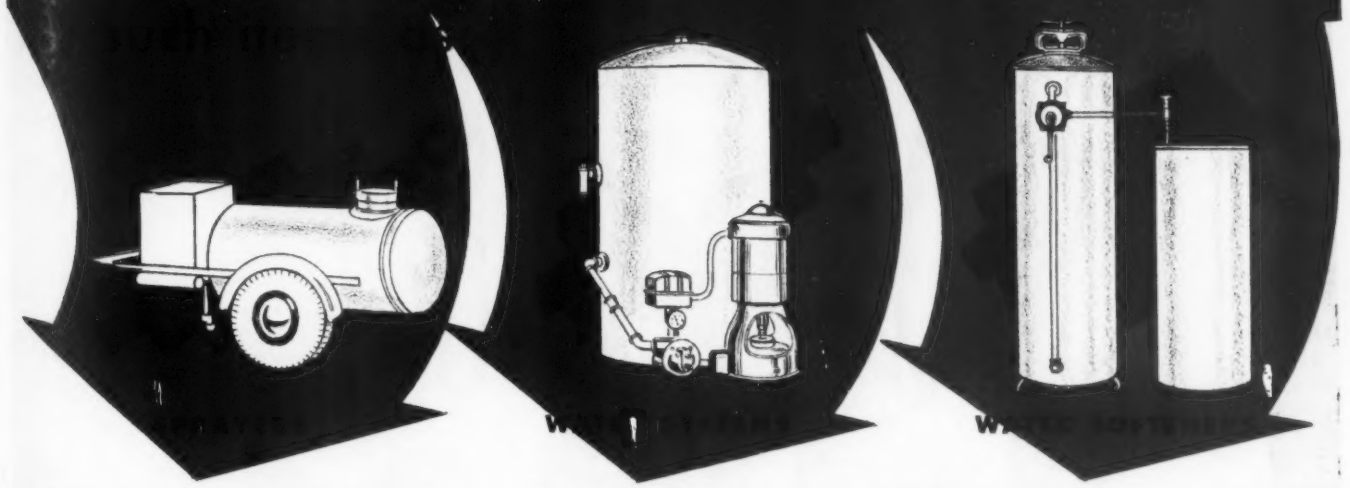
Processors of Synthetic Rubber and Plastics • Sheets • Extrusions Molded Parts

DIVISION WESTERN FELT WORKS

Largest Independent Manufacturers and Cutters of Felt

4035-4117 Ogden Ave., Chicago 23, Ill. • Branch Offices in All Principal Cities

A MESSAGE



BUY TANKS in this TERRITORY and SAVE

Think of the extra savings you'd make on every unit sent to jobbers in this territory . . . *if you didn't have to ship the tank!*

Here's an unnecessary cost that Brownie can help you avoid. The high shipping and handling costs you now pay when you send a *complete* unit (with tank) across the country are largely due to the weight, size and bulk of the tank itself, and the long travel involved.

SHIP YOUR UNITS TO US WITHOUT TANKS

To save you this expense, here's our plan: Send units (assigned to jobbers in this territory) to *us* complete, but *without tanks*. Just furnish instructions as to type, size and specifications of tank, plus assembly details.

WE'LL INSTALL TANKS, RESHIP TO YOUR JOBBERS

Brownie craftsmen will then install necessary tanks on your products *exactly* as you direct, box assembled units carefully, and reship to your jobbers in nearby states . . . at *less* total cost to you.

- Make more sales in distant markets; meet competition.
- Save on shipping and handling charges.
- Have tanks installed here. Costs less; saves time.

WRITE TODAY for complete details about this new plan. We shall gladly estimate savings you'll make from this service. . . . Be first to benefit and profit from Brownie's cost-cutting service-plan.

OUR MODERN PLANT SERVES YOU BETTER, CUTS YOUR COSTS!

Brownie's ultra-modern, well-staffed plant has complete facilities for fabricating steel plate products, including a large assortment of forming dies, jigs and presses, plus latest equipment for shearing, notching, cutting, forming and welding.

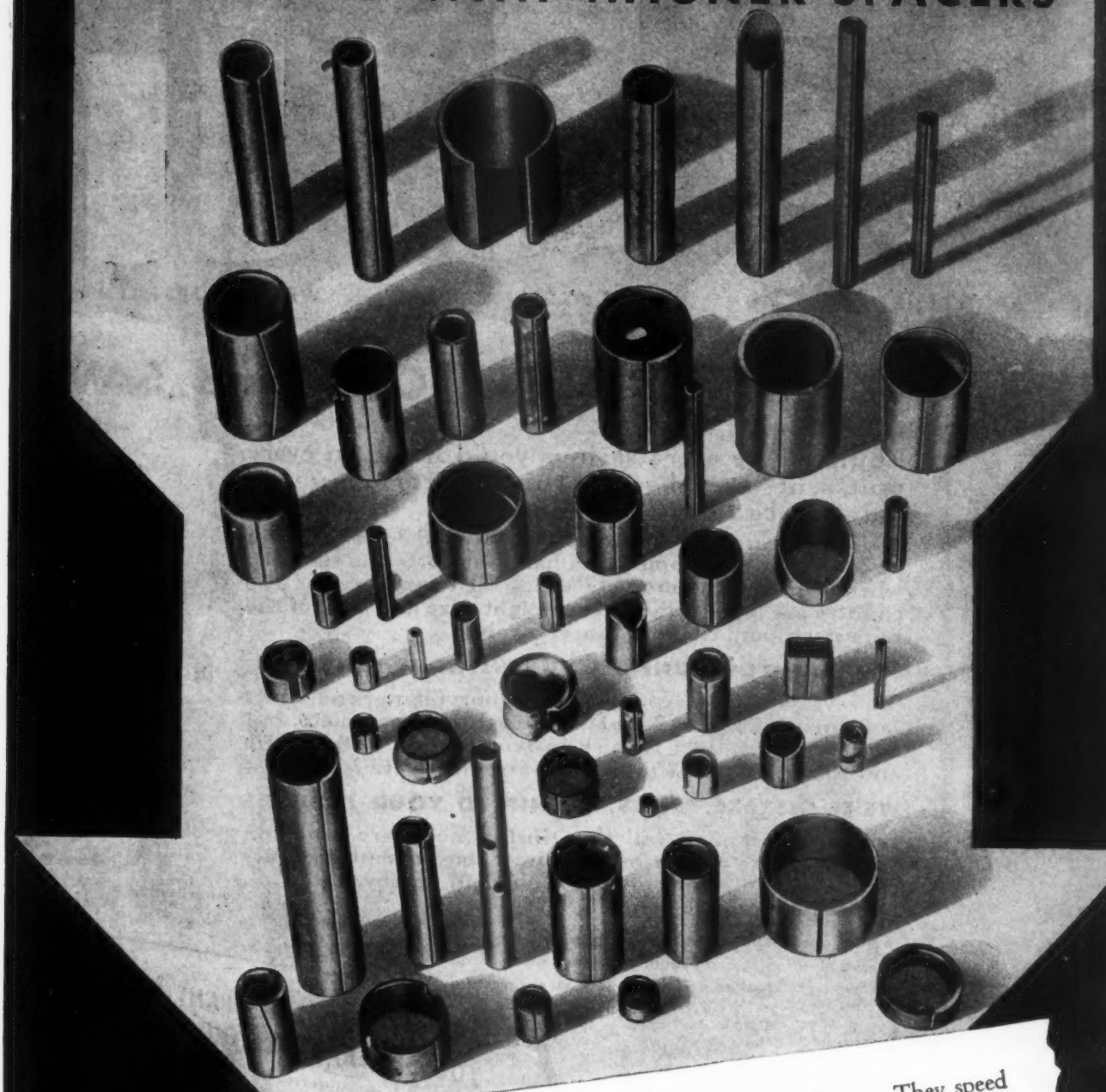
You save more . . . from Brownie!

TRADE MARK REG

BROWN STEEL TANK COMPANY

NOT AFFILIATED • ONE OFFICE, ONE PLANT • MINNEAPOLIS, MINNESOTA

YOUR PRODUCTS CAN PROBABLY BE IMPROVED WITH WAGNER SPACERS

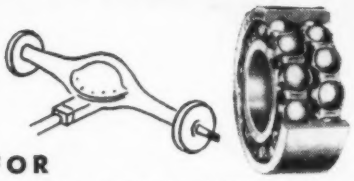


NEARLY every product in every field needs Spacers. We have perfected a new method of producing them, on specially designed automatic machines, in any metal and in a large variety of sizes and shapes. Every day manufacturers find new uses for Wagner Rolled Butted-Joint Spacers and Bushings. They speed up production and are economical to use. Investigate the use of Wagner Spacers in your products. Write today.

E. R. WAGNER MFG. COMPANY
4619 N. 32nd Street • Milwaukee 9, Wisconsin
Since 1899 producers of Metal Specialties, Continuous Hinges, Hinges and Hardware.

FOR A WORLD OF USES

POST-WAR

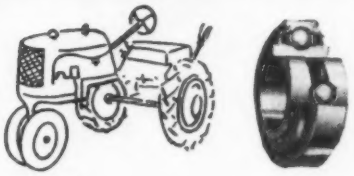


FOR

Heavy Radial and Thrust Loads
Combinations of Heavy Loads
Heavy Thrust (Either Direction)
Great Axial Rigidity

SELECT

FAFNIR 5000 Series
DOUBLE ROW BEARINGS
Bore sizes:
10 Mm to 140 Mm



FOR A Frictionless Seal
A Permanent Seal
100% Effective Seal
Longer Bearing Life

SELECT

FAFNIR MECHANI-SEAL
TYPE BALL BEARINGS
Furnished with single seal, double seal, seal and shield combination and with provision for relubrication.

FOR

Non-Pulley End of electric motors.
Interchangeability of motor end-bells.
Elimination of lock nuts and washers.
Interchangeability with Double Row Bearings.

SELECT

FAFNIR EXTENDED
INNER RING TYPE BEARINGS
Bore sizes:
17 Mm to 140 Mm

FOR

Combinations of Light Loads
Weight and Space Saving
Easiest Installation
Positive Protection against dirt

SELECT

FAFNIR LAK LIGHT
PILLOW BLOCKS
For shaft diameters from 9/16" to 2 7/16".

When you reach a "Turning Point"... STOP!

The bearings that supported every rotary moving part in your pre-war models may be far down the line in comparison with developments in ball bearing design and in available self-contained units.

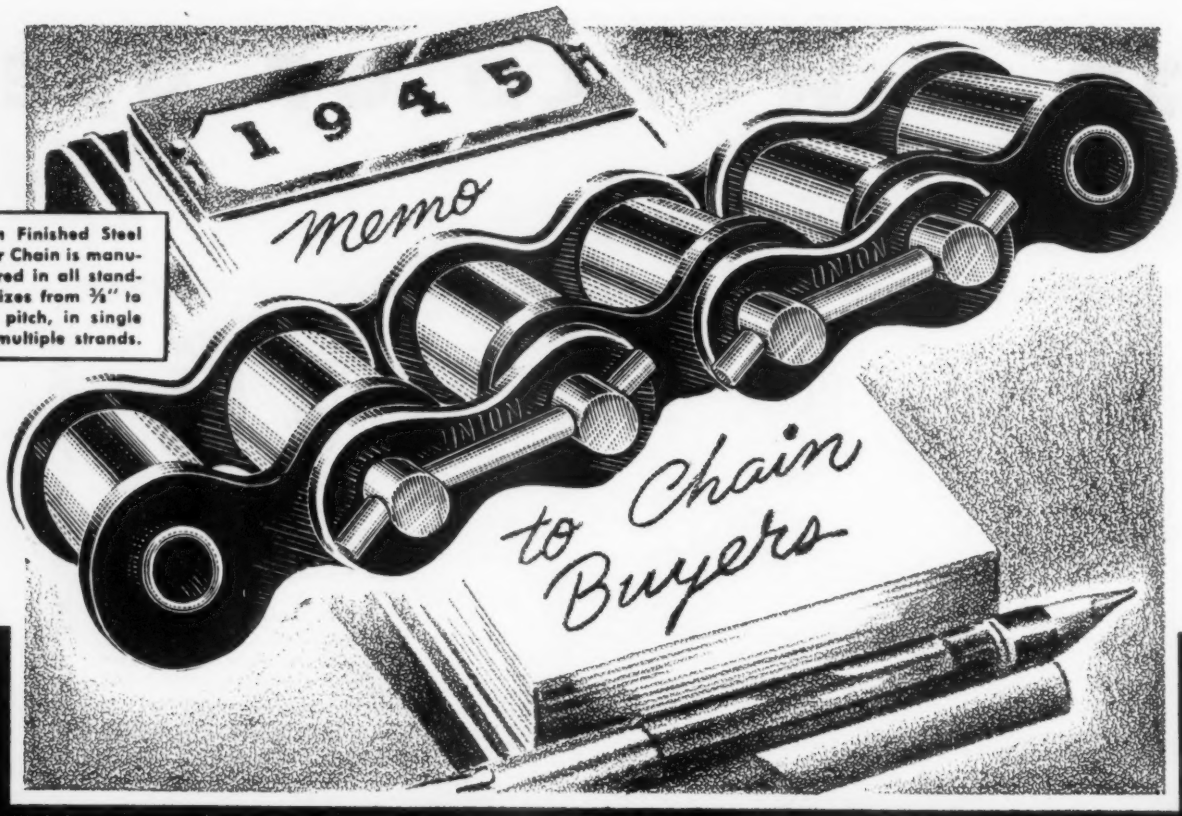
Post-war advances are not limited to mystery products like electronics, nor to the eye-appeal qualities of plastics. Performance is still a matter of the efficient operation of moving parts.

Because Fafnir has a greater variety of types of ball bearings, we are working with a correspondingly greater variety of manufacturers. A development in ball bearings for a textile machinery maker, for instance, may offer multiple benefits to you.

One of Fafnir's strengths lies in this better informed field engineering service. Use it. The Fafnir Bearing Company, New Britain, Conn.

FAFNIR
BALL BEARINGS

BUY MORE WAR BONDS AND STAMPS



Union Finished Steel Roller Chain is manufactured in all standard sizes from ⅜" to 2½" pitch, in single and multiple strands.

A Good Year To Buy Union Chain

Because this year will bring peace much nearer, if not actually realized, and our thinking will turn more to the making of products for use in the postwar world. The same Union Chains now being assembled as integral parts of many war machines will be ready to perform similar operations in peacetime products and to accept assignments of power transmission and materials handling in their production. Every year is a good year to buy Union because Union Chains and the organization by which they are made have a reputation with chain buyers for "wearing well".

The Union Chain and Manufacturing Company ..... Sandusky, Ohio, U. S. A.

Union Catalog A-2 covers Drive and Conveying Chains. Catalog B-2 covers Finished Steel Roller Chain and Sprockets. Ask for your copies.

UNION CHAINS

Union Chains for Every Application

Drive and Conveying Chains and Sprockets
- Bridge Chain
- Combination Malleable Iron and Steel Chain
- HB (hardened bearing) type chain
- BP (bar and pin) type chain

★

Finished Steel Roller Chains and Sprockets
- All manufacturer's standard, size ⅜ in. to 2½ in. pitch
- Single and Multiple Strands
- Extended Pitch Series in sizes 1¼ in. to 4 in. pitch

★

Silent Chain and Sprockets
- All sizes ⅜ in. to 1½ in. pitch

★

Flexible Couplings
- Roller chain type
- Silent chain type

Because *wide-awake* inspectors at Corbin remove the culls and duds, and make sure that every Corbin Screw you receive is uniformly O K . . .

CORBIN-PHILLIPS Recessed Heads

REGULAR SLOTTED Heads with Saw-cut Slots

always correct in size and shape and centered accurately. These uniform features make for quick and easy driving. You'll save time when you use Corbin Screws. *And time is money!*

Look to CORBIN

for your requirements in Screws and Nuts . . . a full range in both CORBIN-PHILLIPS and Regular Slotted. Also AIRCRAFT Screws and Nuts to Governmental specifications.

See your Distributor

—also complete stocks at Chicago, New York and New Britain . . . and sales representatives who can "talk shop."

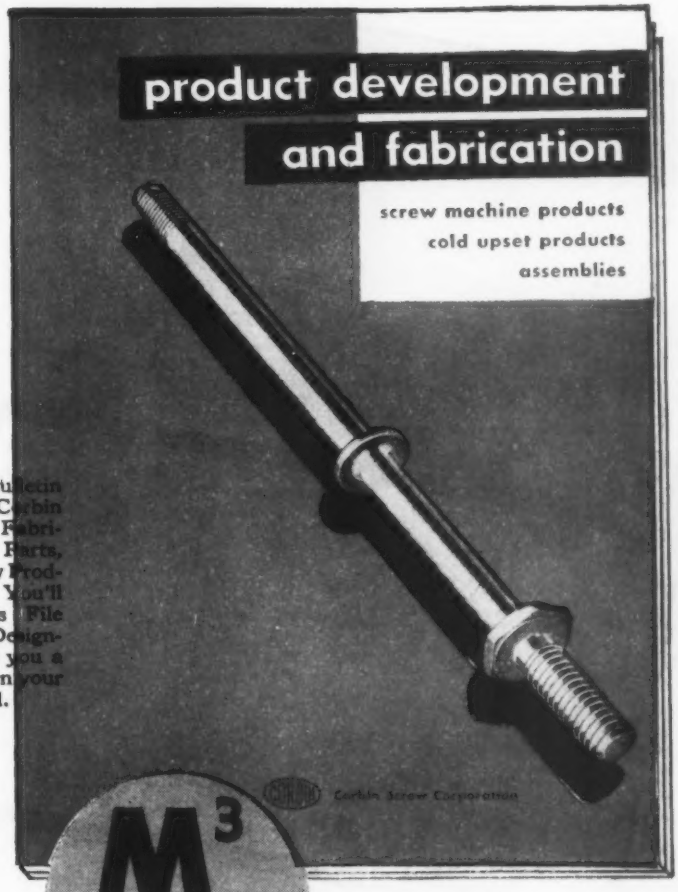
S-12

M³ MEN MATERIALS MACHINES **facilities**

that have made Corbin Headquarters for Precision Parts are producing highest quality Screws . Nuts . Chain.

Look to Corbin for

Standard Parts



This interesting bulletin tells the story of Corbin Development and Fabrication of Precision Parts, Assemblies and New Product Engineering. You'll find it in Sweet's File 4m10 for Product Designers — or we'll send you a copy. Please write on your company letterhead.

M³ MEN MATERIALS MACHINES

Corbin facilities mean better precision parts

. . . better than ordinary screw machine parts! Because here at Corbin we don't have to *start* or *stop* with the Screw Machines. Corbin M³ facilities include batteries of headers, grinders, thread rollers, millers . . . in addition to hundreds of automatics. Corbin's men, materials and machines mean *full* fabrication, modern scheduling control . . . assuring economy, rapid production, full inspection — and any quantity desired.

Corbin welcomes the opportunity to work with manufacturers in the design and development of Precision Parts — and offers its M³ facilities to insure high standard accuracy and dependability.

S-1

THE CORBIN SCREW CORPORATION

The American Hardware Corporation, Successor

NEW BRITAIN CONNECTICUT

CORBIN

See Sweet's Product Design Catalog, outline of Corbin Products and Facilities

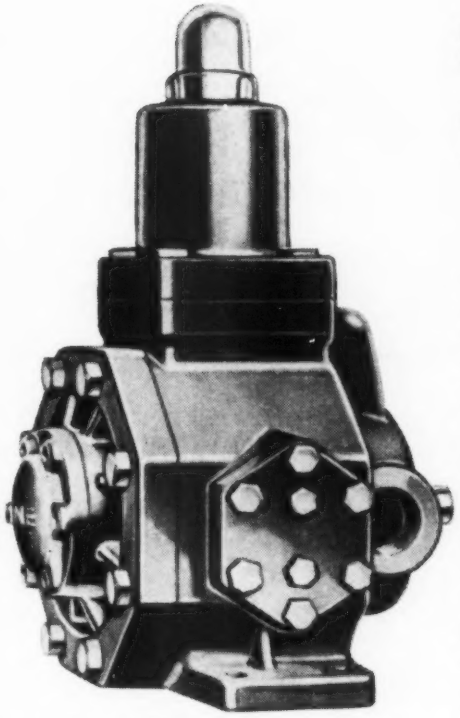
Precision Parts

● T-J Products have shown outstanding ability to "take it"... performing tough jobs for industry with unbeatable *accuracy, efficiency* and *dependability!*

That's why more and more practical production men *specify* T-J where there's a job for Rivitors ... hydraulic cylinders ... or air cylinders ... cutters ... Clinchors ... or air controls. All T-J Products expertly engineered ... precision-built ... rigidly inspected ... right in every respect! Send for latest bulletins. The Tomkins-Johnson Company, Jackson, Michigan.

Variable volume

OIL HYDRAULIC PUMPS



50 to 1000 lbs. pressure

1 to 30 gal. per minute from one pump

RACINE "Variable Volume" Pumps supply only the needed volume of oil—no more—no less. Volume control can be regulated automatically or manually.

This equipment supplies the exacting needs of operations requiring variation in volume and pressure. Because both these features are incorporated in a single pumping unit, the cost of the initial installation is less. Continued savings are provided through lower horsepower consumption in daily service. Correct design, precision workmanship, rugged construction and overload capacity insure long life.

RACINE "Variable Volume" Oil Pumps are built in three capacities: 12, 20 and 30 gallons per minute, all designed to deliver pressures up to 1000 lbs. P.S.I. Let our experienced factory engineering staff and field engineers supply recommendations for developing and improving your oil hydraulic circuits.

Write today for our catalog P-10-C. At the same time outline your problem. Full information will be supplied without cost to you.

RACINE TOOL AND MACHINE COMPANY

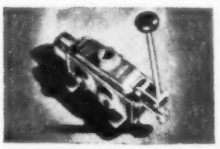
1772 State Street Racine, Wisconsin, U. S. A.

RACINE ECONOMIES

- ★ No oil heating loss through pumping excess oil.
- ★ Relief valves are eliminated, the Pump varies the volume.
- ★ Less horsepower required—because no excess oil is pumped.
- ★ Tilted multiple vanes of special design reduce ring and rotor wear.

SLEEVE TYPE VALVES REDUCE CIRCUIT SHOCKS

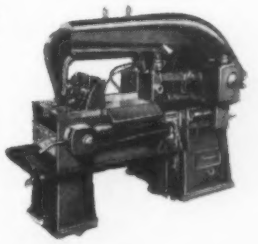
RACINE's complete line of Oil Hydraulic Valves utilize a sleeve design. When these valves are operated, the flow of oil is gradually measured or tapered off—shock present in valves with quick closing ports is eliminated.



Sleeve design also provides the advantage of variation in porting arrangements. RACINE Control Valves in 3/8" to 1 1/2" standard pipe sizes. Manual, mechanical or electrical control devices can be provided.

The Production Saws of Modern Industry

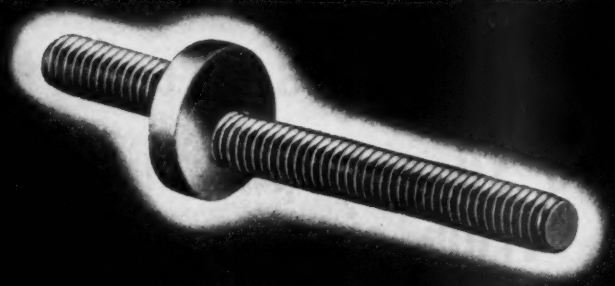
Use RACINE Metal Cutting Machines for your metal sawing operations. Models for general shop work as well as heavy duty production jobs. All price ranges and capacities—6" x 6" to 20" x 20". May we send you catalog No. 12 on RACINE Metal Cutting Machines?



STANDARD FOR QUALITY AND PRECISION
RACINE
RACINE TOOL and MACHINE CO.

RACINE

SOLVE THAT PROBLEM OF FAST, PRECISE ASSEMBLY BY PLANNING FASTENINGS NOW



"Cold-forging"—proof #27...more each month

3 Standard Fastenings for Production Efficiency

1 Phillips Recessed Head Screws—The modern, effective, time-saving fastening device proven in tens of thousands of assembly lines. Other standard head styles are also available.

2 Self-Tapping Machine Screws—Eliminate separate tapping operations for fastenings to castings, heavy gauge sheet metal, and plastics. Also available with Phillips Recessed Head.

3 Washer-Screw Assemblies—When use of lock washers is indicated, the time-saving of pre-assemblies is obvious. Also available in standard slotted head styles.

From the standpoint of design, industry is already well started on postwar business. This makes it increasingly important to clarify your plans for fastenings today... proper fastenings for your product can well be the difference between a fast and precise assembly job and one involving slow, costly methods.

Play safe with that "all-important" postwar item and choose fastenings — standard or special — early in the product design stage. It's our job at Scovill to help you with that selection by recommending the best modern fastening for your specific need. It may be a featured standard fastening or a part requiring our ingenuity in special design and cold-forging—such as the specially designed cold-forged item illustrated above — making possible delivery with savings in money — materials—motions.

Call our Fastenings Expert to assist you in your selection... profit by Scovill ingenuity in standard or special design and cold-forging. Call *today*.

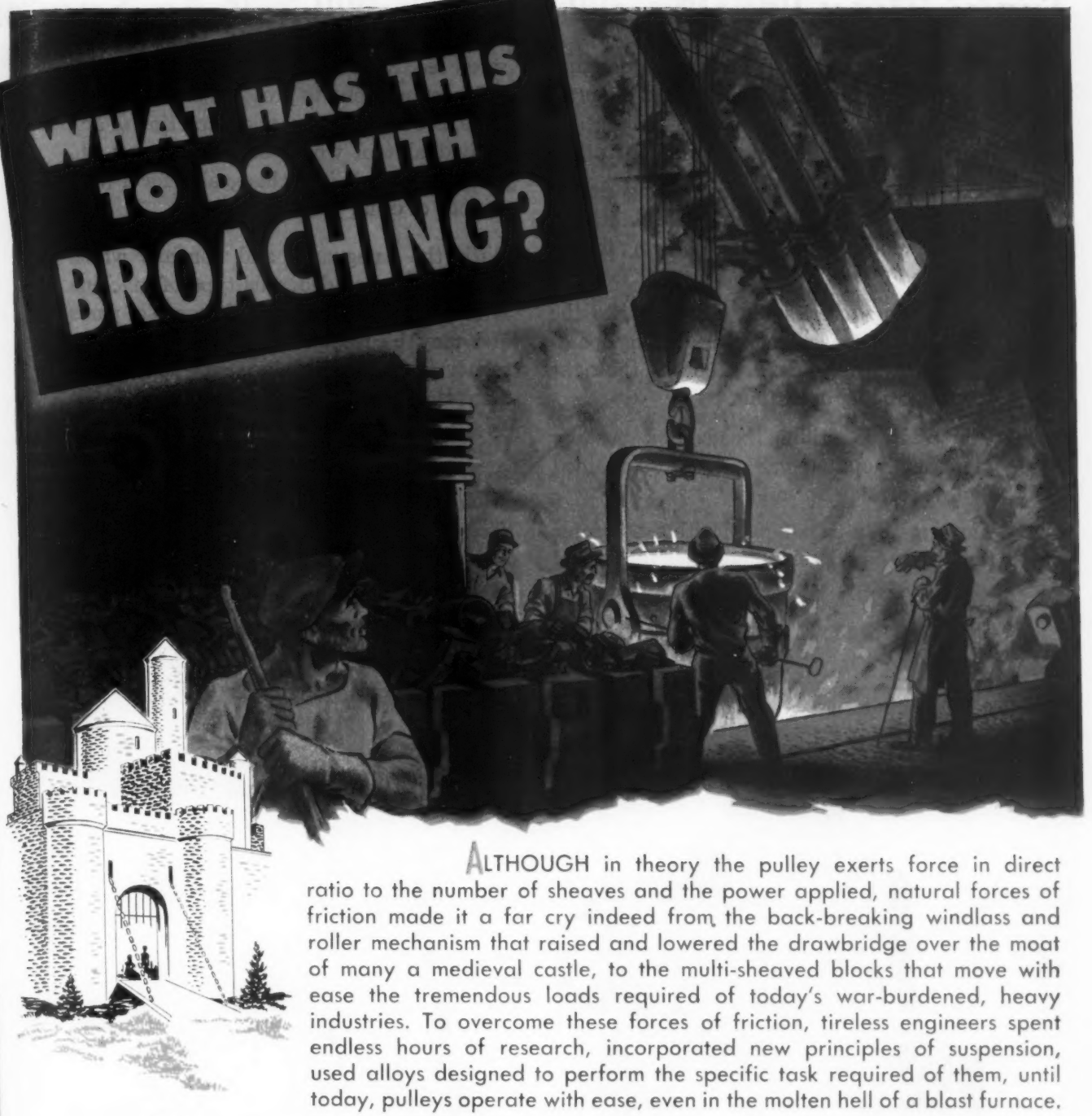
SCOVILL MANUFACTURING COMPANY

WATERVILLE SCREW PRODUCTS DIVISION

WATERVILLE 48, CONN. **TEL. WATERBURY 3-3151**

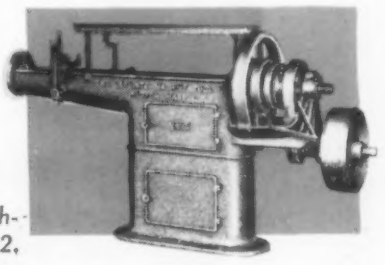
NEW YORK, Chrysler Building • DETROIT, 714 Fisher Building • CHICAGO, 135 South LaSalle Street • PHILADELPHIA, 18 W. Chelton Avenue Building
PITTSBURGH, 2882 W. Liberty Ave. • SYRACUSE, Syracuse-Kemper Insurance Bldg. • LOS ANGELES, 2627 S. Soto St. • SAN FRANCISCO, 434 Brannan St.

WHAT HAS THIS TO DO WITH BROACHING?



ALTHOUGH in theory the pulley exerts force in direct ratio to the number of sheaves and the power applied, natural forces of friction made it a far cry indeed from the back-breaking windlass and roller mechanism that raised and lowered the drawbridge over the moat of many a medieval castle, to the multi-sheaved blocks that move with ease the tremendous loads required of today's war-burdened, heavy industries. To overcome these forces of friction, tireless engineers spent endless hours of research, incorporated new principles of suspension, used alloys designed to perform the specific task required of them, until today, pulleys operate with ease, even in the molten hell of a blast furnace.

TO take advantage of broaching's high-speed, uniformly close-tolerance operation . . . many parts previously thought impossible to produce by broaching methods, have been either re-designed under the impulse of war necessity, or special machines and fixtures designed to produce them. Diligently searching, constantly improving, ever eager to combine modern, labor-saving manufacturing methods with time-proven principles, Lapointe engineers welcome the opportunity to be of service to you in your post-war planning . . . to prove to you by actual production figures that broaching can produce for you . . . quicker, cheaper . . . better!



The first screw-type horizontal broaching machine built by Lapointe in 1902.

ARMY E NAVY

The LAPOINTE Machine Tool Company

HUDSON, MASSACHUSETTS, U. S. A.

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHES AND BROACHING MACHINES

Eight-Way DRILLING and TAPPING MACHINE *by Snyder*

This large special-purpose machine, designed and built by Snyder, demonstrates the practicality of combining multiple drilling and multiple tapping in a production operation.

The part is clamped in a locating fixture mounted on a 180° index table which, in turn, is mounted upon a ball bearing fixture carriage.

The carriage carries the part, first, to the left end of the machine for the drilling operation, then (after indexing 180°) to the right for the tapping operation.

The multiple drilling heads and bushing plates are mounted on Snyder self-contained hydraulic guide bar units.

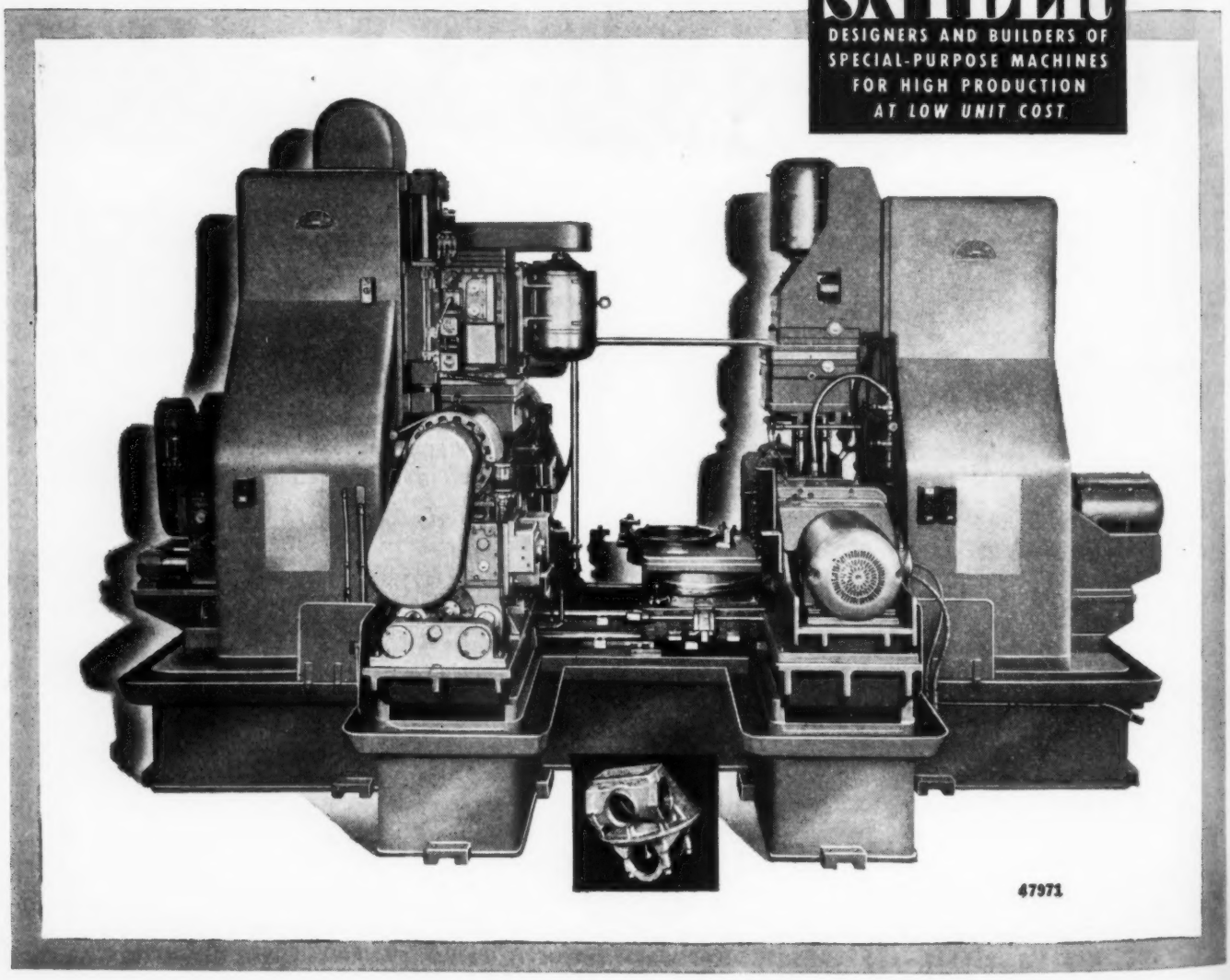
Tapping units are equipped with fixed center tapping heads. Each spindle has individual screw feed and is equipped with ball bearing safety spindle end to protect work piece and tools, providing automatic retraction of any individual tool which encounters any obstacle. All heads interchangeable for a wide variety of other parts.

With the safeguards and controls which Snyder has provided, this type of machine is adaptable to a considerable range of parts and may be retooled again and again, at relatively little cost, since only the equipment is changed.

If your postwar plans call for the efficiency and economy of special-purpose production machines, we invite your inquiry—*Snyder Tool & Engineering Company, 3400 E. Lafayette, Detroit 7, Michigan.*

20 Years of Successful Co-operation with Leading American Industries

SNYDER
DESIGNERS AND BUILDERS OF SPECIAL-PURPOSE MACHINES FOR HIGH PRODUCTION AT LOW UNIT COST



WORLD'S *finest* COUPLINGS ...

HANSEN

HANSEN finest couplings on the market but the most diversified line of couplings ever offered to industry. Included in the Hansen line are couplings for air, oil and grease, another series for acetylene, one for gasoline, one for oxygen and another for steam.

Each series is designed and engineered for a specific type of work and each in turn is leakproof. Take the Hansen air coupling for instance. Here is a coupling that will handle pressures from two ounces to over 10,000 pounds without a leak.

Hansen couplings are the simplest and quickest to operate, the easiest to connect and disconnect. Slight push of plug into socket, they are connected absolutely tight; easy pull on sleeve, they are disconnected. No twisting or turning to lock or unlock, no kinking of hose, no jamming or freezing of parts.

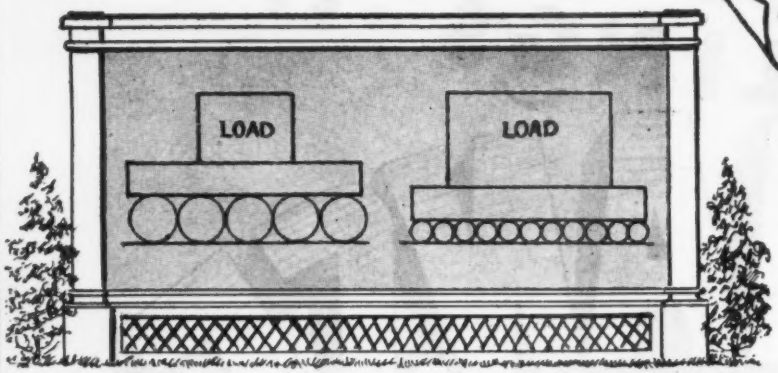
The last word in couplings is Hansen and this is proven by their tremendous popularity in industry all over the world. They are outstanding because of their simplicity, ease of operation, engineering soundness, economical operation and long life. There is no better coupling made anywhere at any price. Send for new free industrial catalog covering the complete Hansen line.

SEND FOR *Free Catalog*

HANSEN MANUFACTURING COMPANY

1786 EAST 27th STREET • CLEVELAND 14, OHIO

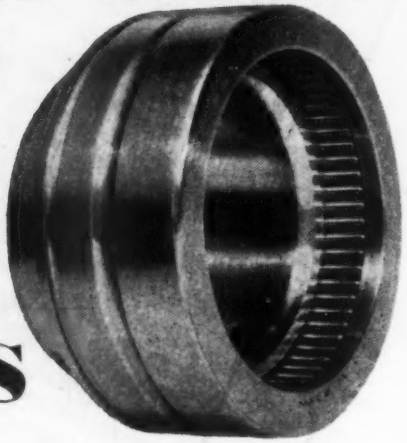
Here's The Simple Formula!



CLUES to better Bearing Performance

- HIGH LOAD CAPACITY
- LIGHT WEIGHT
- SMALL SIZE
- UNIT CONSTRUCTION
- ECONOMY
- WEAR RESISTANCE
- CORRECT ALIGNMENT
- ALL TYPES— Full Range of Sizes
- PRECISION
- High Carbon Alloy Bearing Steel
- ELIMINATION OF FRICTION
- SILENCE

HIGH LOAD CAPACITY—
A Most Important Feature of
RBC NEEDLE BEARINGS



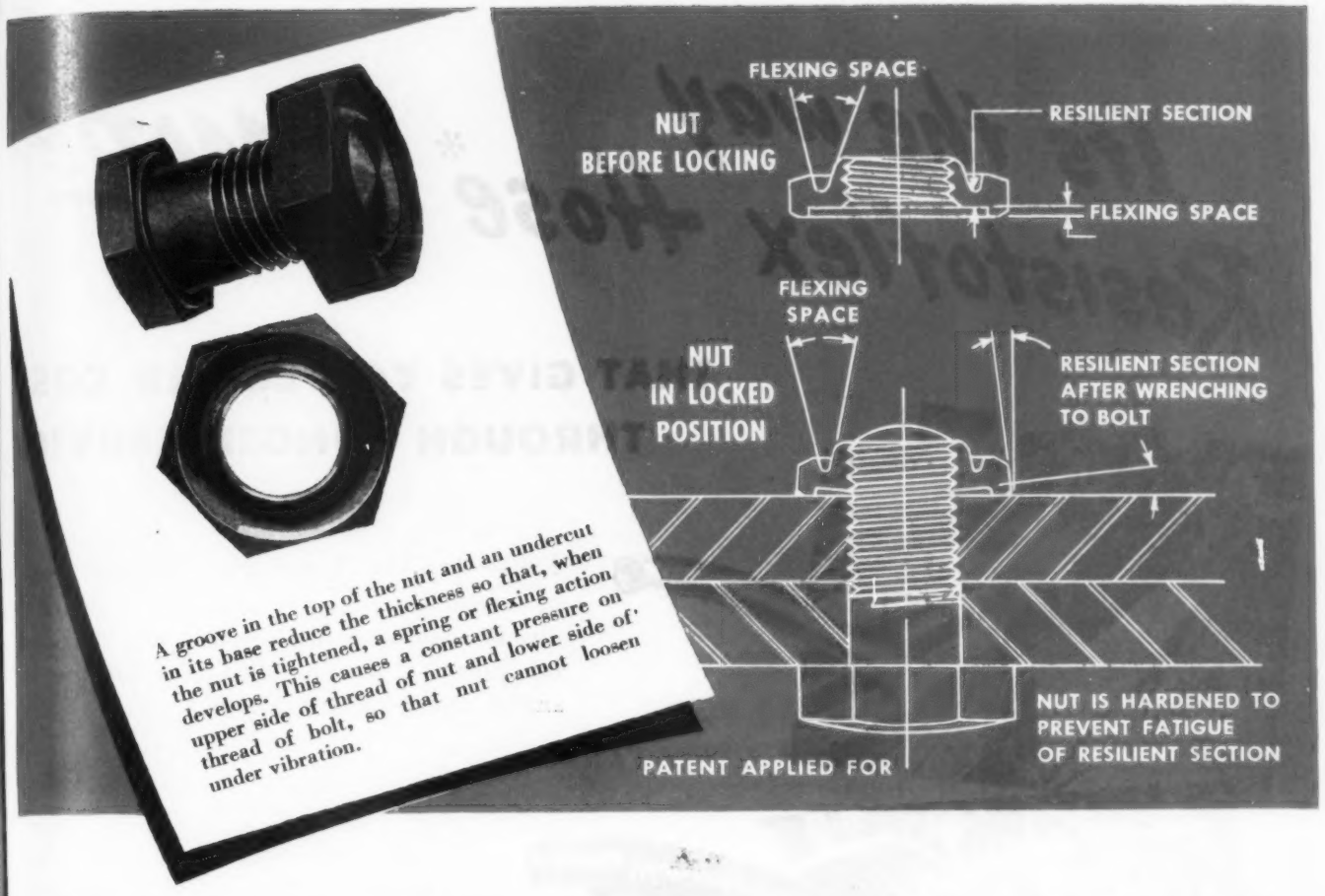
The principle of high capacity in a needle bearing is as obvious as simple multiplication. The more load carrying elements that are placed in a bearing, the greater is its capacity.

The needle bearing affords the use of the maximum number of load carrying elements and thus is capable of withstanding substantially greater loads than bearings having fewer load carrying elements.

RBC needle bearings are made of SAE-52100 steel thus assuring the machine designer of the finest material to insure long life under very heavy loads.

R B C's ENGINEERING STAFF WILL HELP YOU IN SELECTING THE RIGHT BEARING, AND IN FOLLOWING OUT THE CORRECT BEARING PROCEDURE. LET US KNOW YOUR PROBLEMS.

ROLLER BEARING CO. OF AMERICA
TRENTON, NEW JERSEY


FLEXING SPACE
NUT
BEFORE LOCKING
RESILIENT SECTION
FLEXING SPACE
FLEXING
SPACE
NUT
IN LOCKED
POSITION
RESILIENT SECTION
AFTER WRENCHING
TO BOLT
NUT IS HARDENED TO
PREVENT FATIGUE
OF RESILIENT SECTION
PATENT APPLIED FOR
A groove in the top of the nut and an undercut in its base reduce the thickness so that, when the nut is tightened, a spring or flexing action develops. This causes a constant pressure on upper side of thread of nut and lower side of thread of bolt, so that nut cannot loosen under vibration.

MAKE SURE *YOUR* PRODUCT WON'T HAVE THE "WOBBLES"

This is no ordinary bolt and nut. It is new and unique . . . a custom-made cure for the "wobbles". It illustrates how manufacturers are improving their products by consulting with National *on fasteners:*

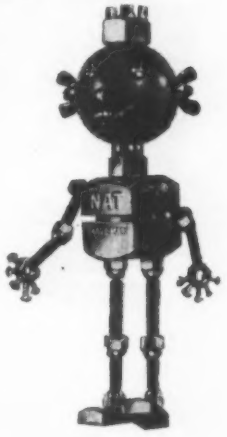
The American Fork and Hoe Company, in redesigning their new line of "True Temper" products, needed a bolt and nut assembly for certain applications that would lock up tight, yet permit delicate adjustment for proper functioning of the tools, and be capable of easy disassembly for sharpening.

The nut had to be thin, light in weight, one-piece construction. Existing types of lock nuts were too cumbersome.

They put it up to us to find the answer. We designed a new type of lock nut (patent applied for) which, when tightened, develops a *spring* or *flexing* action that eliminates the possibility of the nut loosening in action.

Appearance was a factor, too. This was improved by making the top of the bolt slightly oval, and rounding the point so as to blend in assembly with the radii of the nut.

Let us diagnose *your* products for possible fastener improvement. It's often surprising what can be done.

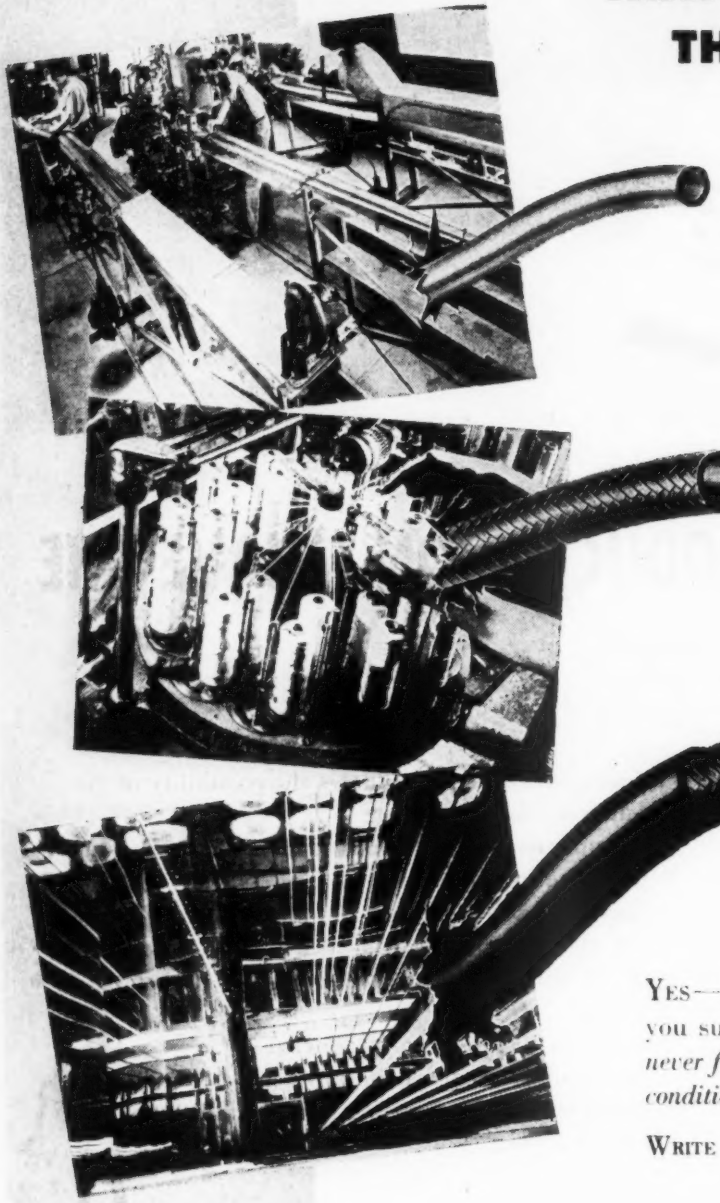


National
HEADED AND THREADED
PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

It's the way Resistoflex Hose* is MADE

THAT GIVES YOU LOWER COST THROUGH LONGER SERVICE



FIRST—AND MOST IMPORTANT—the tube* is made of compar, an elastomer completely immune to attacks of gasoline, fuel oils, hydraulic fluids and lubricants. Compar *cannot* shrink in inner diameter, swell, rot or slough-off.

NEXT—ADDED STRENGTH—with no loss of flexibility—is supplied by integrally bonded fabric reenforcements.

FINALLY—AN OUTER COVER—for protection against abrasion, man-handling, and for fine appearance and colorful identification.

YES—IT'S THE WAY Resistoflex makes this hose that gives you such service advantages—and why *Resistoflex hose has never failed under vibration or flexing under normal operating conditions.*

WRITE FOR COMPLETE INFORMATION AND TECHNICAL ASSISTANCE

*The Tube is the Heart of the Hose, Insist upon its being Compar

ARMY E NAVY

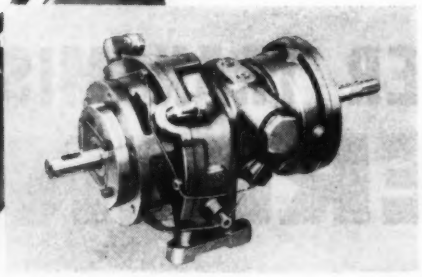
RESISTOFLEX

RESISTOFLEX CORPORATION, BELLEVILLE 9, N. J.

MACHINE DESIGNERS CAN TAKE A TIP FROM THE USE OF OILGEAR TRANSMISSIONS IN AMERICA'S NEWEST, MOST EFFECTIVE ANTI-AIRCRAFT GUN

A typical example of the almost unlimited flexibility of Oilgear Fluid Power, the things you can do with it, is the highly successful use of Oilgear Transmissions in America's newest and most effective 40 MM anti-aircraft guns. Two Oilgear Transmissions serve each gun. One moves the carriage from side to side, the other elevates the gun muzzle. The two transmissions are self-synchronizing and work automatically on signals from the director-mechanism. Enemy planes may come in from any direction, at tree-top level as well as at great heights. Hence, these Oilgear Transmissions provide rapid slewing and elevating speeds with precise, rapid and accurate deceleration as the gun centers on the target, and appropriate following speed. Plane evasive tactics are met by variable synchronization of the two directions of travel. Easy and speedy disengagement and re-engagement of automatic operation is also provided. These Oilgear transmissions are small, powerful, dependable.

In the functions outlined above, or elsewhere in the wide range of characteristics of Oilgear Fluid Power you are almost certain to find a better solution to the problem that confronts you. Write for further information or put your problem up to Oilgear Engineers. Do it *now*. . . . THE OILGEAR COMPANY, 1311 West Bruce Street, Milwaukee 4, Wisconsin.



External view of Oilgear new, smaller, efficient, high speed transmissions as used on newest 40 MM anti-aircraft gun control system which also incorporates travel limit switches, unlimited azimuth angle and increased elevation angle, push-button controlled high-speed slewing, increased torque and speed of operation.

ARE YOU TRYING TO:

1. Apply large forces through long . . . or short . . . strokes at variable speeds? **2.** Obtain automatic work cycles, variable speeds in either direction . . . with or without pre-set time dwell? **3.** Apply large forces through continuous or intermittent reciprocating cycles at constant or variable velocities? **4.** Obtain extremely accurate control of either position or speed of a reciprocating member? **5.** Apply accurately variable pressure either static or in motion? **6.** Closely synchronize various motions, operations or functions? **7.** Apply light . . . or heavy . . . forces at extremely high velocities through either long or short distances of travel? **8.** Obtain continuous automatic reversing drives at constant R.P.M. or over a wide range of speed variation? **9.** Obtain accurate remote control of speed and direction of rotation, rates of acceleration and/or deceleration? **10.** Obtain constant horsepower output through all or part of a speed range? **11.** Obtain automatic torque control? **12.** Obtain accurately matched speed of various rotating elements? **13.** Obtain constant speed output from a variable speed input? **14.** Obtain full pre-set automatic control, elimination of problems of shock, vibration, etc.?

You Need Oilgear!

OILGEAR

Fluid Power

FOR BETTER POWER TRANSMISSION
Consult PERKINS!

Engineers engaged in the design and manufacture of equipment requiring gears for the transmission of power will find the cooperation of our technicians valuable. To impart maximum efficiency to power transmission requires a degree of skill in the design and engineering of gears that only a long and diversified experience can provide. This "know-how" is available to you. For as specialists in the manufacture of custom-cut gears, the collective experience of our technical staff on problems of power transmission could not easily be duplicated. This service is offered to industry free and freely. Consult Perkins now!

PERKINS MAKES:

Helical Gears	Bevel Gears	Ratchets
Worm Gears	Spiral Gears	Spur Gears
Ground Thread Worms		

PERKINS PRECISION, CUSTOM-CUT GEARS

PERKINS MACHINE & GEAR COMPANY, SPRINGFIELD 2, MASS.

To Aim Tin Fish more accurately

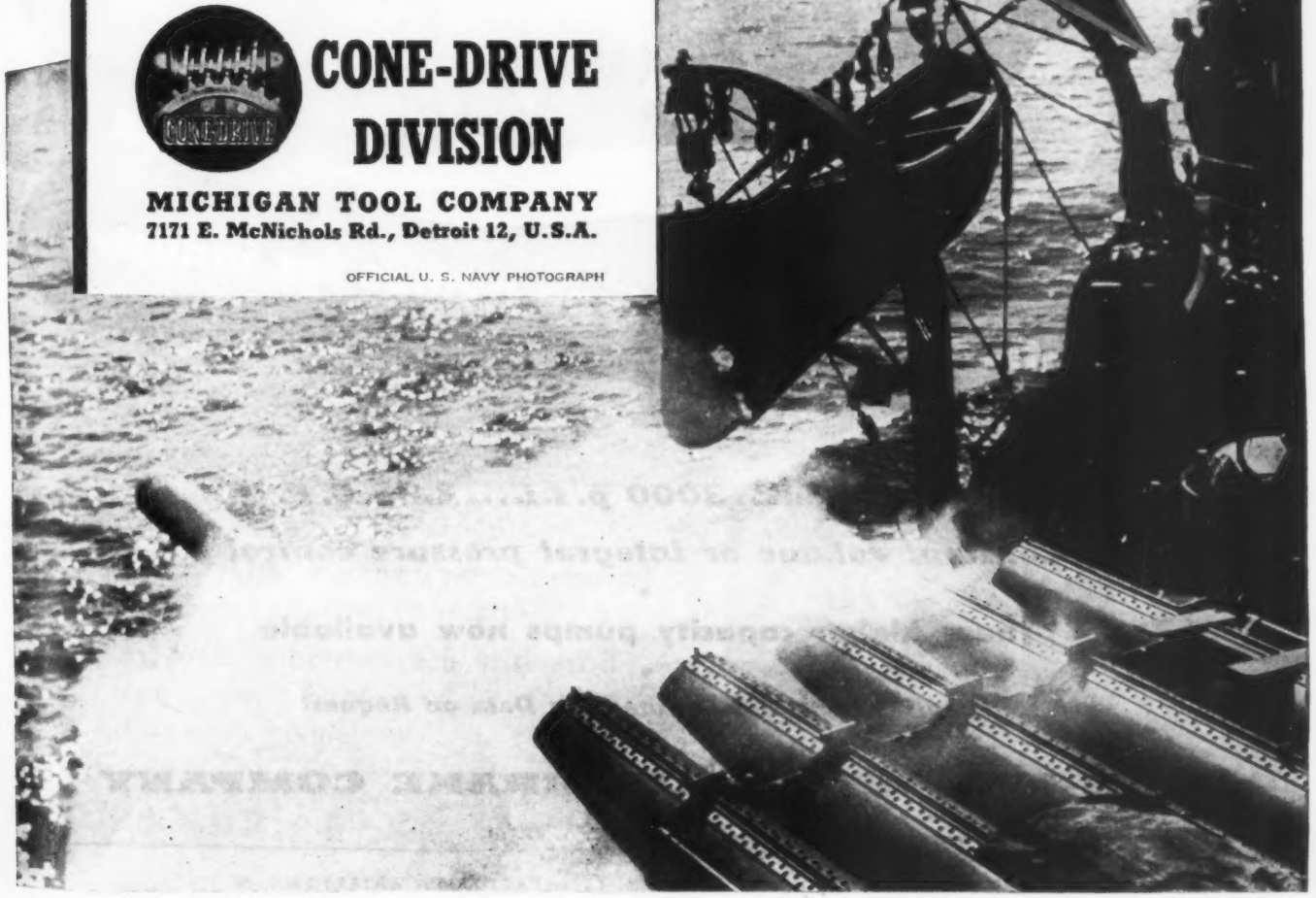
They used to fire torpedoes one at a time. This war changed that. They now fire tin-fish in squads of two, three, four and even five, blanketing enemy vessels. To train those multiple torpedo tubes, gears have to operate with the smoothness of watch mechanisms yet be able to swing the heavy loaded torpedo turrets rapidly into line. There must be no measurable backlash to spoil the aim. We are proud that many of these training mechanisms are powered with 60 to 80 P. D. Cone-Drive gears and of the job they did in helping our Navy obtain mastery of the seas—East and West. That kind of service should enable Cone-Drive gearing to do a real job tomorrow in improving the design of many peace-time products such as heavy mining machinery, boom hoists, mine hoists, and large indexing drives.

What is more, Cone-Drive gearing saves space and weight. Cone-Drives weigh only 1/3 as much, require only 2/3 the room of conventional gearing of the same load capacity.

Ask for the following manuals:
CW-41B (for Executives)
CW-41A (for Design Engineers)

CONE-DRIVE DIVISION

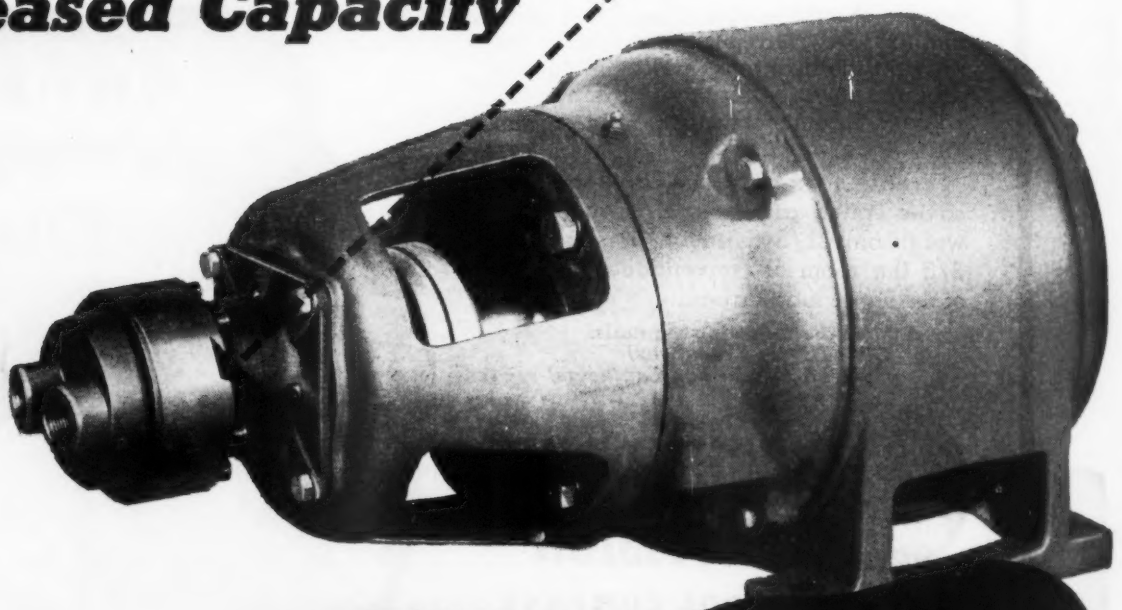
MICHIGAN TOOL COMPANY
7171 E. McNichols Rd., Detroit 12, U.S.A.



OFFICIAL U. S. NAVY PHOTOGRAPH

HYCON

High Pressure with Increased Capacity



Adaptation of aviation-type pumps for industry

Motor mounted... 3000 p. s. i.... 2.25 G. P. M.

Constant volume or integral pressure control

•

These higher capacity pumps now available

•

Specifications and Engineering Data on Request

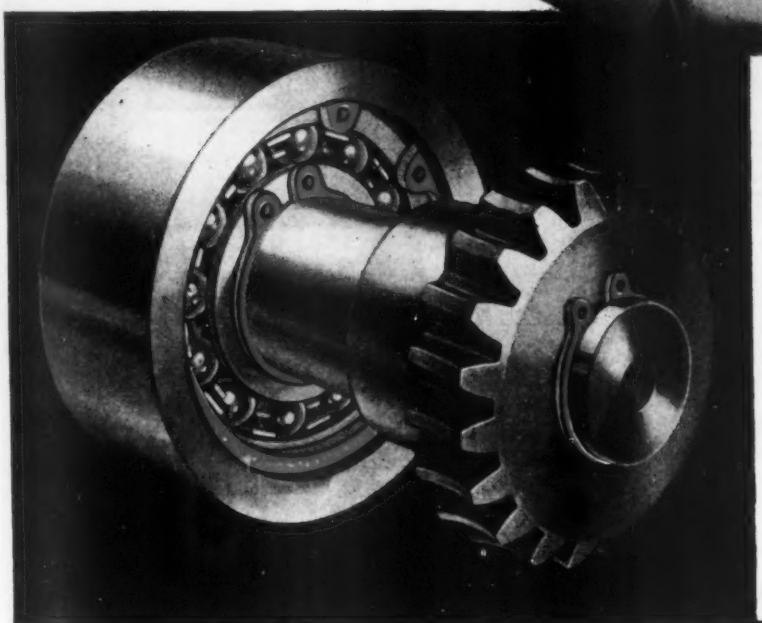
THE NEW YORK AIR BRAKE COMPANY

Hydraulic Division

420 LEXINGTON AVENUE, NEW YORK 17, N. Y. · FACTORIES: WATERTOWN, N. Y.

WALDES TRUARC RETAINING RING

U. S. Patent
Re 18144



For thrust-load fixing, and shaft and housing applications, Waldes Truarc provides distinct advantages over nuts and bolts or wedges and washers... it reduces dimension and weight... saves material... cuts manufacturing time... simplifies assembly and dis-assembly.

On request, we will gladly furnish samples and full data for your tests.

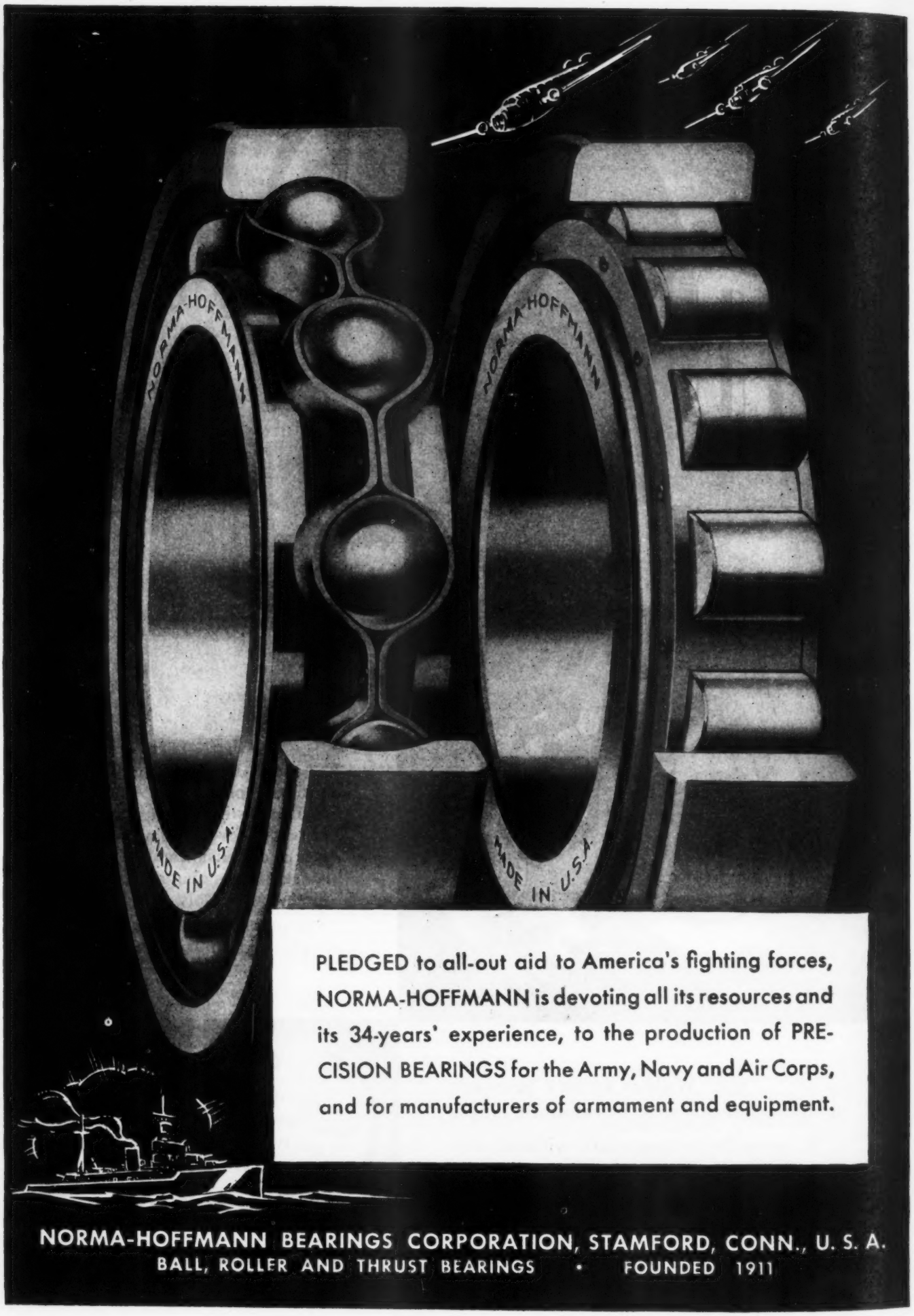
Waldes Truarc presents a significant advance in retaining rings.

It spreads or contracts without distortion; always retaining its perfectly fitting circular contour.

WALDES KOH • I • NOOR • INC. ★ LONG ISLAND CITY, N. Y.

Sole Manufacturers in U. S. A.

Canadian Representatives: Precco Progress and Engineering Corporation, Ltd., 72-74 Stafford St., Toronto



PLEDGED to all-out aid to America's fighting forces, NORMA-HOFFMANN is devoting all its resources and its 34-years' experience, to the production of PRECISION BEARINGS for the Army, Navy and Air Corps, and for manufacturers of armament and equipment.

NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U. S. A.
BALL, ROLLER AND THRUST BEARINGS • FOUNDED 1911

CONSTANT FLOW OF POWER THROUGH

ROLLING ACTION—

GEARGRIND

RZEPPA CONSTANT VELOCITY UNIVERSAL JOINTS

Catalog on Request

IF YOUR product design calls for the transmission of power from one rotating shaft to another, without vibration and the alternating acceleration and deceleration of old style universal joints, write for the new Rzeppa catalog.

This book explains the mechanical principles involved in transmitting vibrationless, constant, uniform power, and contains diagrams showing the destructive forces set up by older methods of transmitting power through various degrees of angularity.

Rzeppa Universal Joints are made in both the bell and disc types, in a wide range of sizes that are available for many industrial, automotive and marine applications. Full information will be sent on request.

ARMY E NAVY

The GEAR GRINDING MACHINE COMPANY
DETROIT 11, MICH. U.S.A.

Sealed---

مومیا, pronounced Múmiyà . . . Persian for bitumen or mineral pitch found in the mummies of the ancient Egyptians. Thus did they seal against disintegration by the elements, thus did they seal against destruction; by means of black pitch and fragrant balsams.

Modern machines, too, must be sealed against destruction . . . sealed against the loss of oil which protects their vital bearings.

National Oil Seals keep that oil where it must stay for safe and uninterrupted performance. National Seals make possible the unprecedented achievements of these machines . . . planes, tanks and tractors; electric motors and dynamos; of countless other intricate mechanisms which can be depended upon only as long as oil remains in contact with their vital bearings.

Wherever shafts move, there you will find National Seals keeping the oil in place . . . seals that are engineered in the world's most modern plants devoted entirely to oil retention problems.

NATIONAL
OIL AND FLUID SEALS

Wherever shafts move

NATIONAL MOTOR BEARING CO., INC.

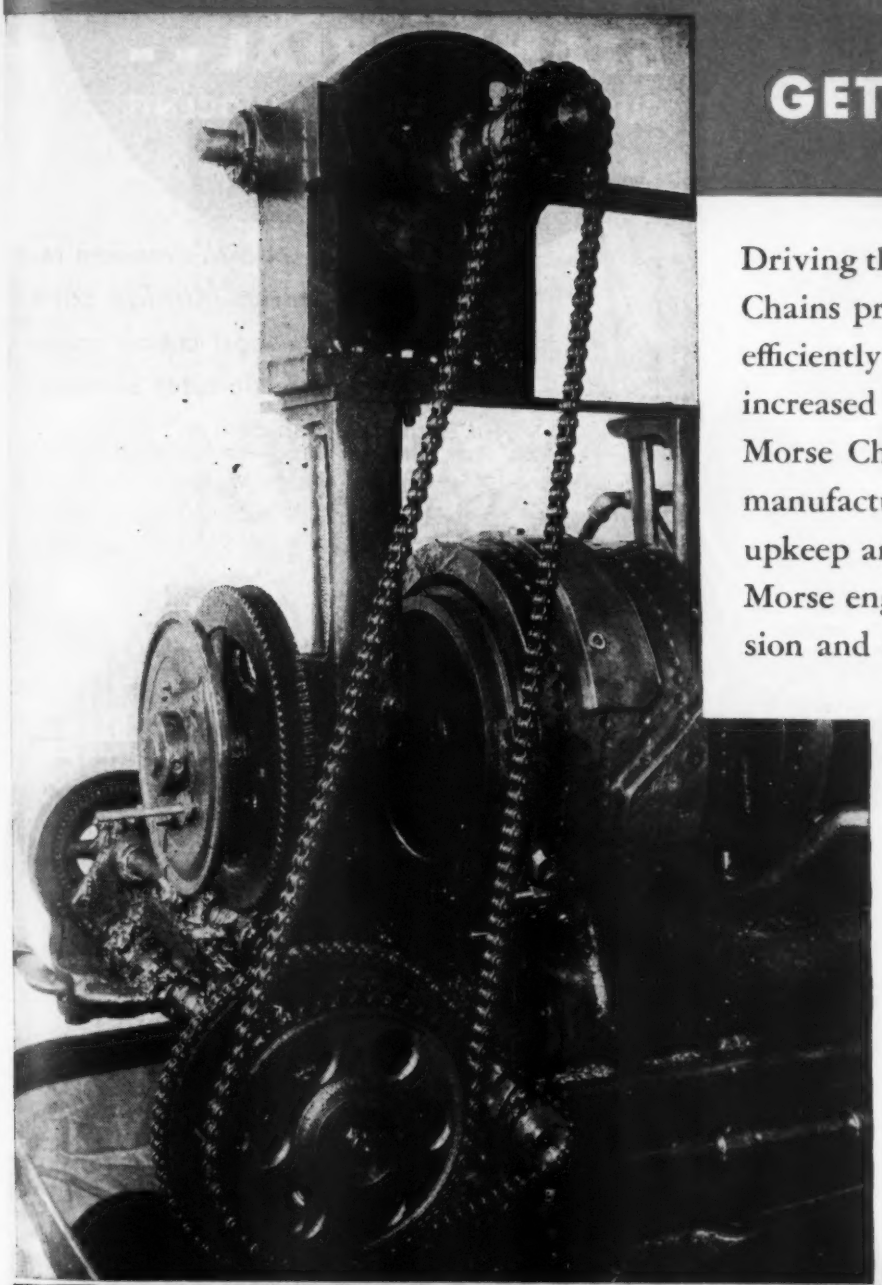
General Offices: Redwood City, Calif. • Plants: Redwood City, Calif. and Van Wert, Ohio
Arrowhead Rubber Company, Los Angeles, Calif.

984

It's the Principle . . .

NO SLIP . . .

THAT GETS RESULTS!



Driving through teeth, not tension, Morse Chains prevent slippage, transmit power efficiently and economically. "Production increased 25% with the installation of Morse Chains"—says one machine parts manufacturer. Save substantially in time, upkeep and replacement costs—consult a Morse engineer on *your* power transmission and control problems.

SPROCKETS CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE Roller and Silent CHAINS

MORSE CHAIN COMPANY • ITHACA, N.Y. • DETROIT 8, MICH. • A BORG-WARNER INDUSTRY

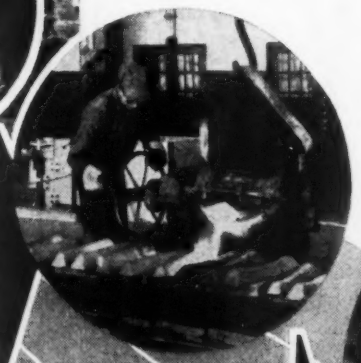
HERE N·B·M BRONZE PARTS STAND TRIAL - -

GUILTY UNTIL PROVED INNOCENT!

In this "court"—N-B-M's modern research laboratories—bronze parts must endure the most critical cross-examinations and tortures unmerciful engineers can devise.

Alloys are analyzed for grain and composition.

"Pours" must prove their metal under fire.



Castings are subjected to every punishment they must endure in actual use.

The judgment of this jury is stern. Only castings that acquit themselves completely under rigid metallurgical and manufacturing controls are worthy to be . . .

N·B·M BRONZE PARTS

NBM

NATIONAL BEARING METALS CORPORATION

ST. LOUIS • NEW YORK

AMERICAN Brake Shoe

PLANTS IN: ST. LOUIS, MO. • PITTSBURGH, PA. • MEADVILLE, PA. • JERSEY CITY, N. J. • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

Compare *Greer* HYDRAULIC ACCUMULATORS

for Simplicity

A Greer Hydraulic Accumulator consists simply of a one-piece seamless steel shell containing a completely enclosed synthetic rubber bag having an integrally molded air valve. No welds. No packing. No air leaks.

Size and Capacity

Greer Hydraulic Accumulators offer more capacity for their size than any other type ever built.

Flexibility

A wide variety of shapes, besides the standard sizes listed below, are available to fit practically any space. For larger capacity, units may be hooked up in parallel in the system.

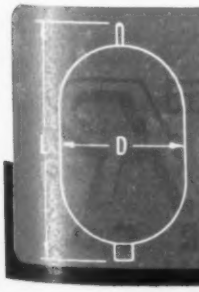
Base of Installation

Installation may be in any convenient position with a simple bracket to support the small weight of the unit.

Cost and Upkeep

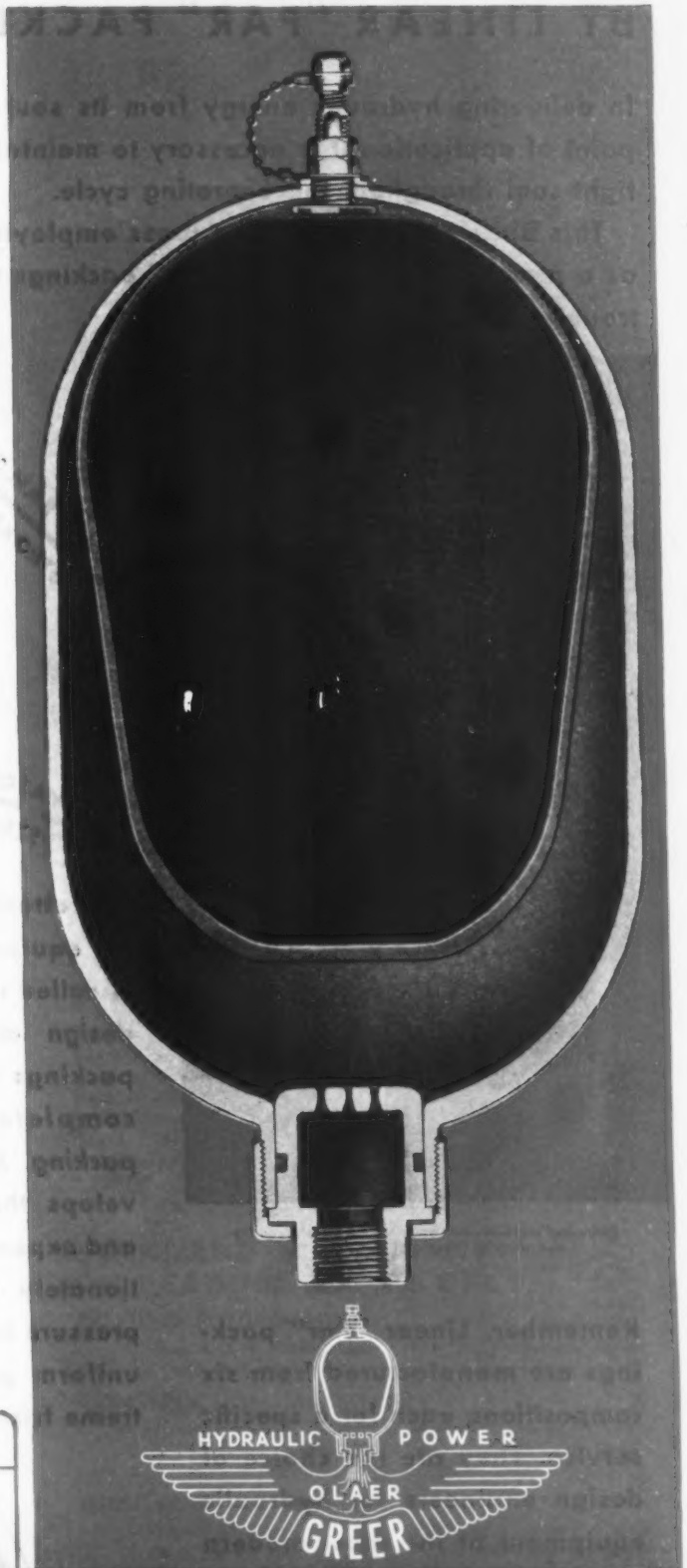
The first cost and maintenance expense of a Greer Hydraulic Accumulator are much less than for any unit of similar capacity. It was designed for the armed forces to give dependable service under the most severe conditions.

Let our engineering department help you with your problem.



CAPACITY GALLONS	L INCHES	D INCHES	OPERATING PRESSURE, psi
.333	8-1/16	4-1/8	3000
1.	12-5/8	6-1/4	3000
2.5	17-3/4	8-5/8	3000
5.	24-5/8	8-3/4	2000
10.	31-5/8	10-3/4	1000
*25.	52-5/8	12-3/4	1000

*On Special Order Only



GREER PRODUCTS CORPORATION
39 West 60th Street, New York 23, N. Y.

VITAL HYDRAULIC POWER ...EFFECTIVELY SEALED IN... BY LINEAR "PAR" PACKINGS

In delivering hydraulic energy from its source to the point of application it is necessary to maintain a fluid tight seal throughout the operating cycle.

This Birdsboro Steam Platen press employing water as a pressure medium, uses "Par" packings to insure trouble free, leak proof performance.

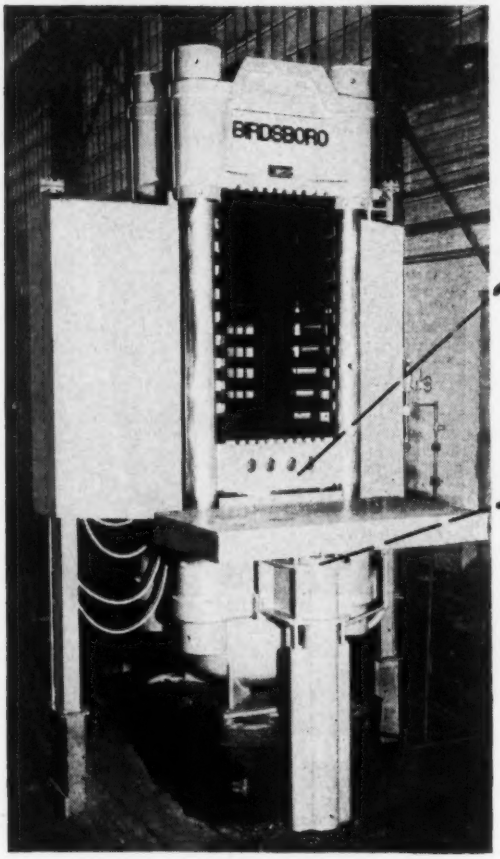
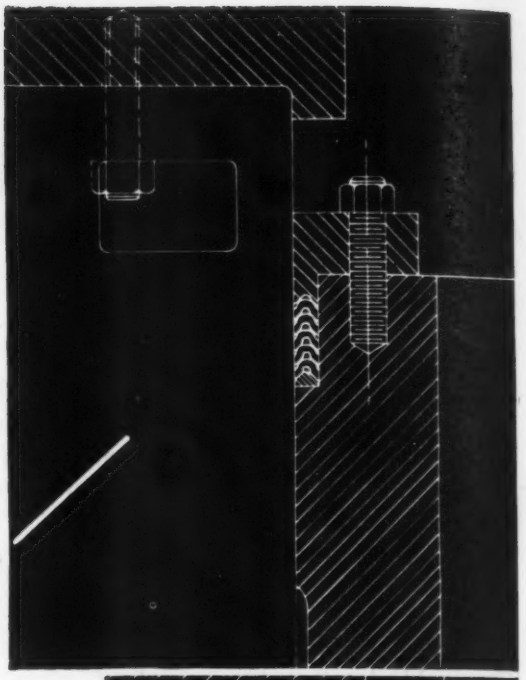
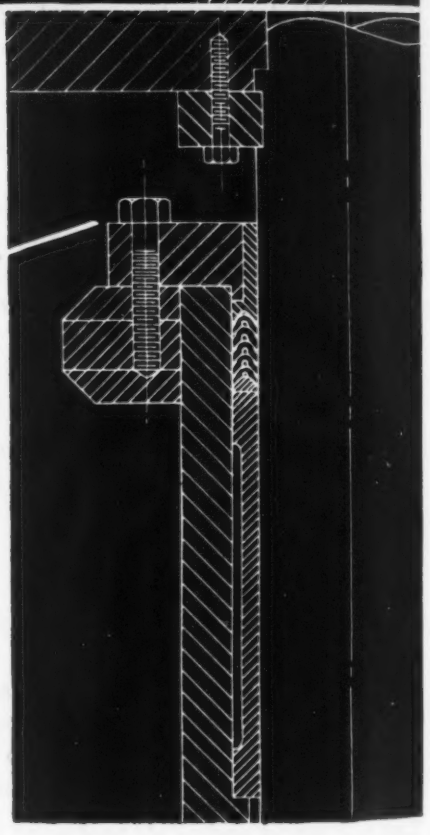


Photo and sketches courtesy Birdsboro Steel Foundry and Machine Company, Birdsboro, Pa.





The attention of hydraulic equipment designers is called to the *distinctive design* of Linear "Par" packings which insures a *completely automatic packing*. As pressure develops the lips expand, and expansion is proportionately reduced when pressure is lowered, insuring maximum efficiency and uniform pressure maintenance, also eliminating extreme friction and wear.

Remember, Linear "Par" packings are manufactured from *six compositions*, each for a specific service. They are the choice of design engineers for hydraulic equipment of the most modern type. The consultation of Linear engineers is available . . . sample rings upon request.

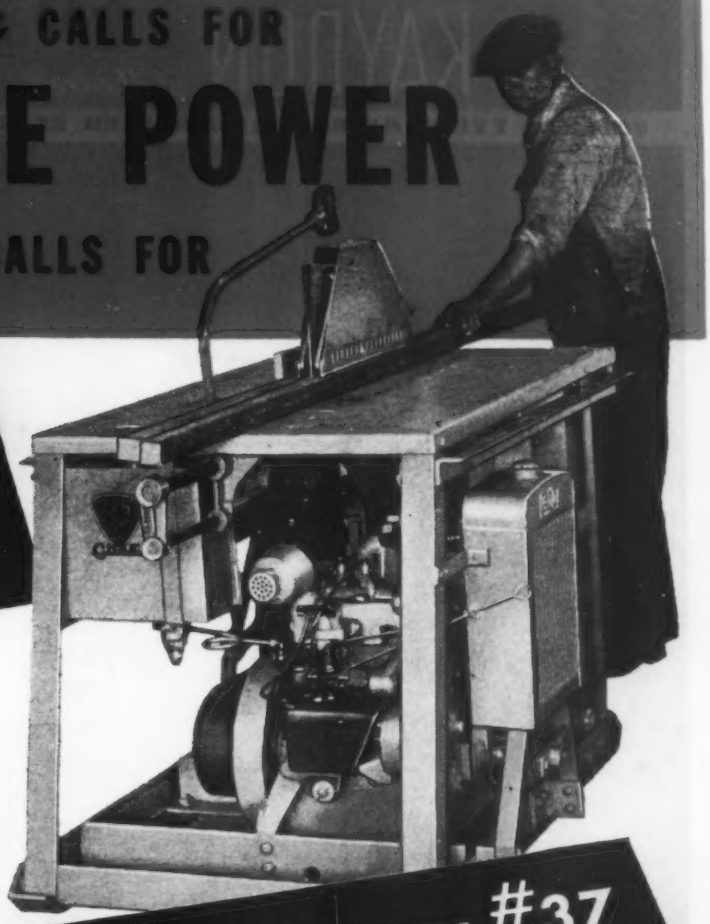
LINEAR
PACKING & RUBBER CO.
STATE ROAD & LEVICK STREET
TACONY, PHILADELPHIA 35, PENNA.

WHEN *Good Design* CALLS FOR

DEPENDABLE POWER

Good Judgment CALLS FOR

Le Roi Engines



Case History #37

D-1

Portable power by Le Roi pays off in savings and satisfaction . . .

For results that build a reputation for operating dependability and economy, it pays to power your equipment with engines from a source that is made to order for your purpose — concentrating exclusively on the problems of the heavy-duty field, and prepared to adapt components and accessories to your own specialized requirements.

Le Roi engines are designed from scratch for heavy-duty service; they are not "converted" engines, nor does Le Roi accept any business which involves sacrificing its quality standards to meet a price.

They have the weight and stamina to stand the punishment handed out to field equipment, without costly breakdowns. They are proving it every day on the battlefronts of the world — as they have done for years in the oil fields, on construction projects, wherever tough conditions test soundness of design and quality of materials and workmanship.

Le Roi engines are popular not only for their dependability and economy, but also for special Le Roi features which speed up field maintenance and keep the engines in service with minimum loss of productive hours.

When you install Le Roi's, you get engines with a reputation, that helps to sell your equipment—backed by a nation wide service organization.

Le Roi offers you a substantial, proved source—with facilities devoted especially to this field — and competent engineering assistance based on experience with a great variety of power requirements. Consult us, without obligation.

This C. H. & E. heavy-duty saw is dependably powered with a Model XP Le Roi Engine . . .

Built for rapid cross-cut work and heavy ripping of lumber up to 6", this saw rig is powered by a 4 cylinder 15 H.P. Le Roi engine. All parts are readily accessible for quick maintenance.

Engine Features — Close-grained grey iron pistons, accurately ground and weighed • Accurately honed cylinders in a block of electrically refined alloy iron • Ball bearing mounted, flyball type governor, automatically lubricated, completely enclosed • Balanced carburetors, fixed jet type • Fully enclosed, high-tension type magneto • Centrifugal pump for water circulation.

STANDARD EQUIPMENT ON LEADING MAKES OF:

LE ROI MILWAUKEE

OILFIELD EQUIPMENT

Drilling Rigs • Well Pumps • Pipeline Gathering, Receiving, and Mainline Pumps • Generators.

CONSTRUCTION MACHINERY

Concrete Mixers • Bituminous Mixers • Cranes • Draglines • Power Shovels • Pumps • Hoists • Rollers • Crushers • Scrapers • Saw Rigs • Etc.

INDUSTRIAL MACHINERY

Industrial Locomotives • Water Pumping Stations • Cotton Gins • Dehydrators • Cranes • Water Drilling Equipment • Conveyors • Etc.

AGRICULTURAL MACHINERY

Harvesters • Spray Rigs • Feed Grinders • Hay Balers • Pea Vining Machinery • Etc.

Le Roi Company

1708 S. 68th St. • Milwaukee 14, Wisconsin

Heavy-duty liquid-cooled internal combustion engines 4 to 400 H.P. — for gasoline, natural gas, or butane

Contact KAYDON *of Muskegon*

FOR ALL TYPES OF BALL AND ROLLER BEARINGS 4" BORE TO 120" OUTSIDE DIAMETER

Typical of KAYDON precision is the spherical roller bearing. 4.3307" I. D. x 7.0866" O. D. x 2.2047" wide illustrated above. KAYDON Bronze or steel retainers; super-precision or standard tolerances.

PROPORTIONATE to a tolerance of .0001" on a 6" diameter — that is the extreme precision with which KAYDON produces ball and roller bearings in diameters up to 120". Few attempt such difficult accuracy.

KAYDON, *specializing* in the production of all types and sizes of bearings, offers an outstanding service that banishes the need for compromising on a "standard" bearing that cannot fill your exact needs.

Atmospheric control in heat treating, rarely provided by special bearing manufacturers, is available at KAYDON. In addition, KAYDON offers added services in flame hardening, precision heat-treating, metallurgical laboratories, microscopy and physical testing.

Counsel in confidence with KAYDON. While vital wartime requirements have precedence, capacity for general production is constantly increasing. Look ahead — and plan ahead — with KAYDON!

KAYDON *Types of Standard or Special Bearings:*
Spherical Roller • Taper Roller
Ball Radial • Ball Thrust
Roller Radial • Roller Thrust

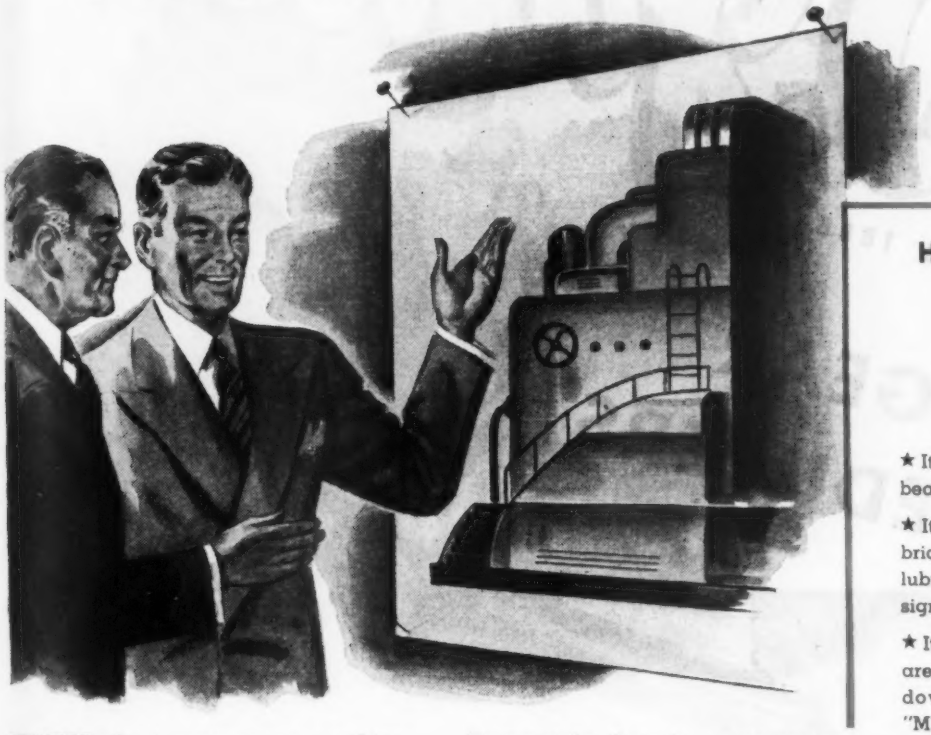
THE KAYDON ENGINEERING CORP.

MUSKEGON • MICHIGAN

New in Name . . . Old in Experience

YOUR MACHINE IS YOUR "PIN-UP"

Protect it from Costly Human Error!



THERE she is—*your* new machine, *your* "pin-up" gal! She has lines and looks. Yes, even personality!

And now she's ready to leave your care and earn her way in the world. Ready to do a certain job better than any other machine in her class!

In doing that job your "pin up gal" is going to be at the mercy of people . . . human beings who make mistakes. And those mistakes can rob your "beauty" of her full productiveness.

Fortunately, there *is* a way you can insure your "gal" against costly human error. You can protect her *for life* with any one of the four new Alemite Centralized Lubrication Systems for use with grease or oil. They're so adaptable you can design them into any type of machine, large or small! Today, write for free catalogs of: The Alemite Progressive, The Alemite Dual Progressive, The Alemite Dual-Manifold and The Alemite LubroMeter Systems.

How Alemite Centralized Lubrication Gives Your Machines Special Advantages

★ It assures positive lubrication for all bearings.

★ It provides measured delivery of lubricants to each bearing; prevents over-lubrication or under-lubrication. System signals when lubrication is completed.

★ It permits lubrication while machines are in operation. No time-outs or shut-downs for lubrication, which adds "M. P. T." (More Productive Time) to your machines.

★ It eliminates need for costly field service. Machines perform better because they are properly lubricated.

★ It adds potent sales points to your machines, enhances your own reputation as a designer. Alemite Systems pay for themselves quickly through greater production, lower labor and lubricant expense, longer life of machines.

Typical Ways Centralized Lubrication Adds "Sales Appeal" to Your Machines

Each of a battery of Bullard lathes required 18 minutes time-out for lubrication every 8-hour shift. An Alemite Centralized System now lubricates each lathe from one central point on the lathe *in 1 minute every 6 days!* And the lathes keep on the job during lubrication! Thus this Alemite System adds 338 hours More Productive Time to *each* lathe *every* year!

Giant presses in one plant had to be shut down 1½ hours every day for lubrication. An Alemite Centralized System was installed—stopped that loss cold by servicing all bearings on each press from *one* location *without stopping the presses!* Presto—a loss was changed to a gain! 10 hours More Productive Time was added to each press each week. Multiply that 10 hours by a battery of presses . . . times 52 weeks!

Ask for a Demonstration of the 4 New Alemite Systems . . . Right at Your Desk!

Without obligation, have an Alemite Lubrication Specialist call and demonstrate Centralized Lubrication with four transparent working models. They're mighty interesting. You can study them at close range—actually work them yourself at your desk! If you like, the Alemite Specialist will gladly give you any technical help or information you may want regarding the adaptation of Alemite Centralized Lubrication Systems to your machines. Drop a note on your letterhead to Alemite, 1808 Diversey Parkway, Chicago 14, Illinois. In Canada: Belleville, Ontario.

Another Product of STEWART WARNER

ALEMITE

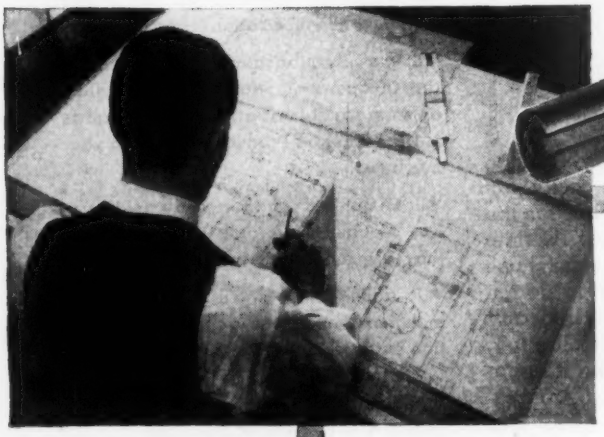
First in Modern Lubrication

CONSULTATION • ENGINEERING • EQUIPMENT • LUBRICANTS • MAINTENANCE

D. O. James

ESTABLISHED 1888

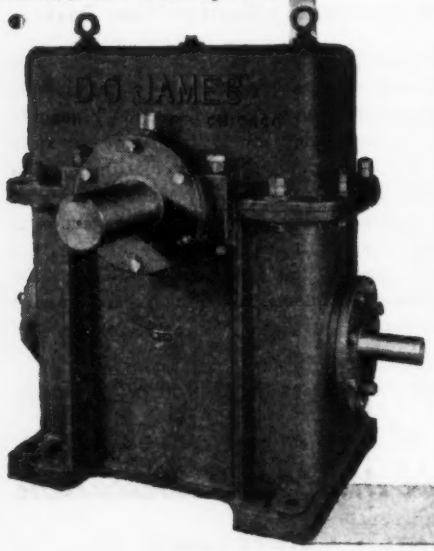
WORM GEAR REDUCERS



Designed and Built for the Successful "Doing of The Job"—

Type "H" Worm Gear Speed Reducer

Horizontal (Illustrated) or Vertical Drive—26 Sizes, Ratio Range of 6 to 65:1, and from 1/32 to 150 Horsepower.



Due to their wide ratio range, the D. O. James Worm Gear Reducers are ideal for many power saving installations. They are designed and built by an organization that has had over a half century of Gear Making Experience and who have successfully pioneered the Gear Reducer to its present high efficiency standards. The many and repeated installations of D. O. James Worm Gear Speed Reducers testify to their superiority and adaptability. These reducers are the result of excelling craftsmanship in our engineering, cutting, grinding, assembling, inspection and testing departments. Their efficiency is further increased in the usage of the best and most suitable materials. An experienced supervision and modern plant facilities assure a finished product that will be successful in "The Doing of The Job."

D. O. JAMES MANUFACTURING CO.

4417 Roosevelt Road • Chicago, Illinois

Makers of Every Type of Gear and Gear Reducer

MORGANITE SEAL RINGS

To designers and engineers now considering post-war projects, the outstanding performance of MORGANITE carbon components in military use is of particular importance. While aircraft parts are representative of but one phase of industry, these do stress the multiple inherent advantages responsible for their wide specification in vital equipment.

Seals for de-icing equipment, motor accessories, instruments, propeller assemblies, fuel valves and pumps, ventilating and hydraulic systems, booster and vacuum pumps, etc., are included in numerous MORGANITE applications.

Offering immunity to sticking, gumming or warping even under drastic temperature fluctuations—and imperviousness under acid, solvent or alkali immersion without impairment of self-lubricating properties — MORGANITE meter valves, slides, bearings, seal washers and rings are produced with metallized or graphited content. Machined or super-finished to close tolerances, components can be plated, bonded to rubber, or furnished with fastenings.

Typical Self-Lubricating Seal, used in aircraft accessories, is immune to most solvents and fumes.

MORGANITE blades and impellers will not gum, stick, warp or corrode—are resistant to acids.

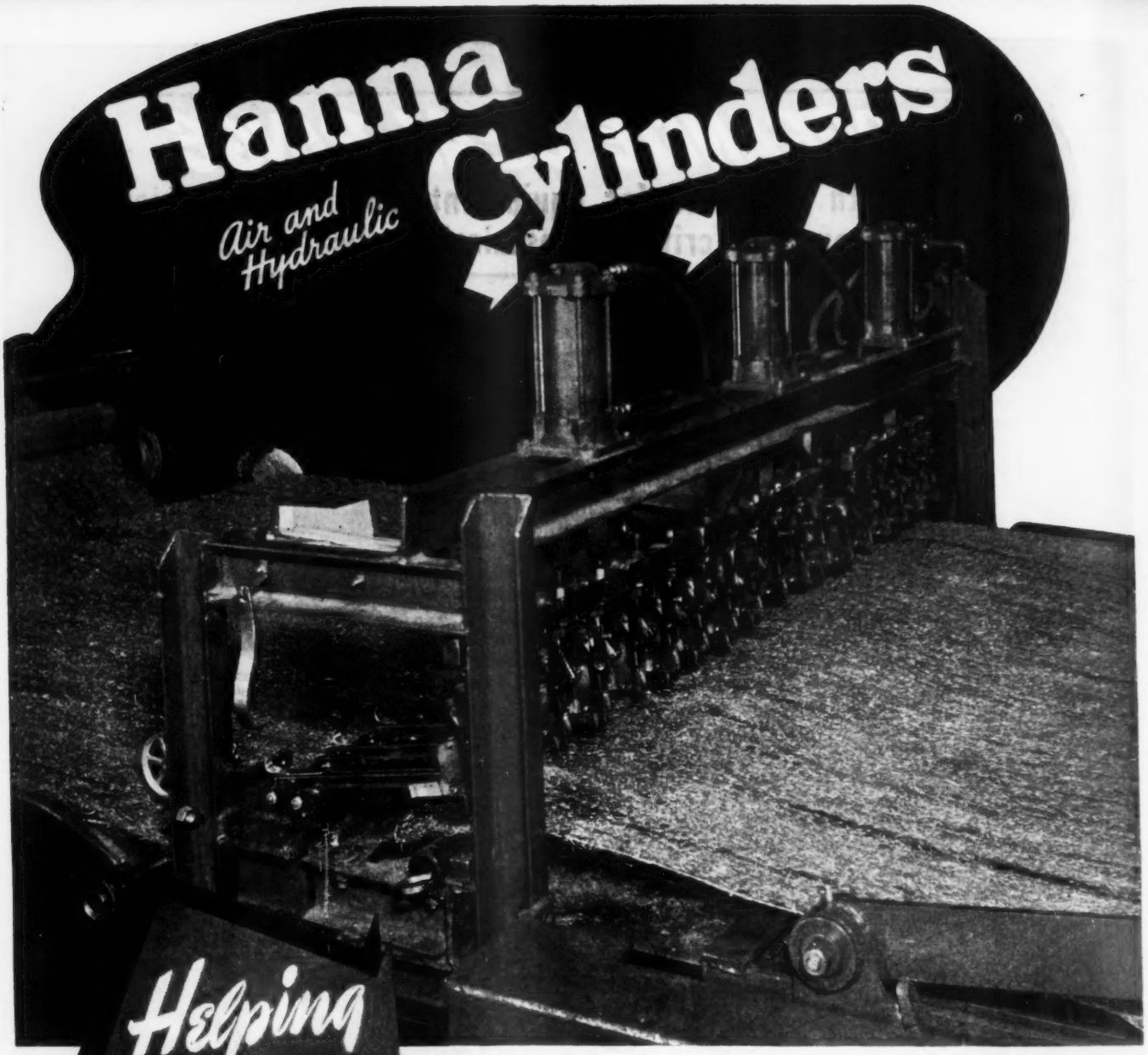
This seal bearing is entirely self-lubricating, and functions in high ambient temperature.

Instrument bearings of MORGANITE assure accurate functioning under wide operating conditions.

Write for literature describing the complete line of MORGANITE products, including motor and generator brushes. Brochures will be sent promptly on request without obligation, together with details concerning MORGANITE engineer-designer collaboration.

Morganite

CARBON SPECIALTIES



Helping BUILD MISSES for AXIS BOMBERS

IF the bomber can't see the target, it's a *miss*. And this machine, one of four designed and operated by the Parker Wolverine Co. of Detroit, is building plenty of *misses* for axis bombers by fabricating thousands of miles of camouflage for use by our armed services.

Into these ingenious Parker machines are fed long strips of poultry netting and mats of steel wool to be joined together by gangs of Bostitch Stitchers. Hanna Air Cylinders perform an important function in the operation of these machines by providing the dependable, smooth power thrust which activates the stitchers.

The application of Hanna Air Cylinders in the Parker Wolverine fabricating machine is an example of the advantages of using Hanna Cylinders wherever a pushing, pulling, lifting, pressing, clamping or controlling action is needed.

You can select a Hanna Cylinder to meet practically all requirements of size, power, mounting, etc. They will operate with air, oil, or water—under pressures from 100 to 1500 lbs.

Investigate the advantages of using Hanna Cylinders in the machines and equipment which you design and build. A Hanna engineer will be glad to help you with application problems.

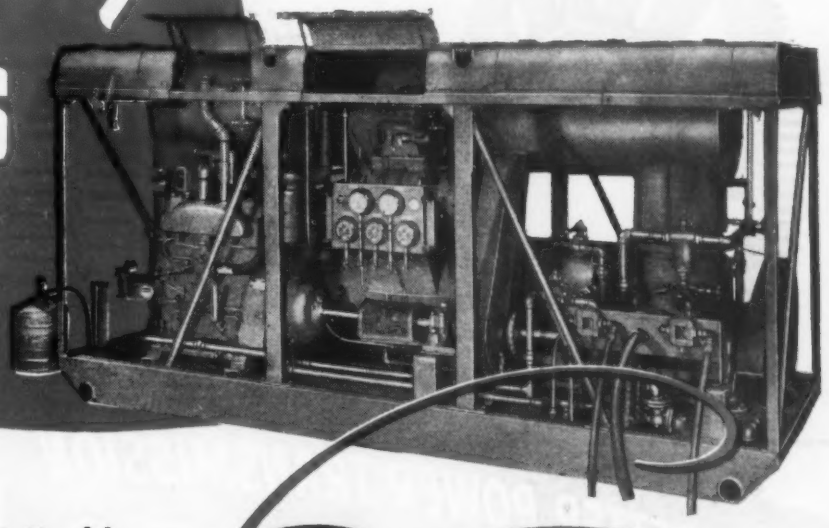
You will want these informative Catalogs. They give complete specifications, details and data to help you select the right cylinders for the job. Catalog No. 230 covers Low Pressure Cylinders; No. 233, High Pressure.

HANNA ENGINEERING WORKS
1765 ELSTON AVENUE • CHICAGO 22, ILLINOIS

Air and Hydraulic
RIVETERS
VALVES

Air and Hydraulic
CYLINDERS
AIR HOISTS

Saves nearly 4 GALLONS OUT OF 5



Cleaver-Brooks compression-type distillation units such as this deliver up to 175 gallons of potable water for every pound of gasoline consumed. The old ratio was 37 gallons of water for every pound of fuel. Output 175 G.P.H.

—and Safeguards Our Fighters' Health

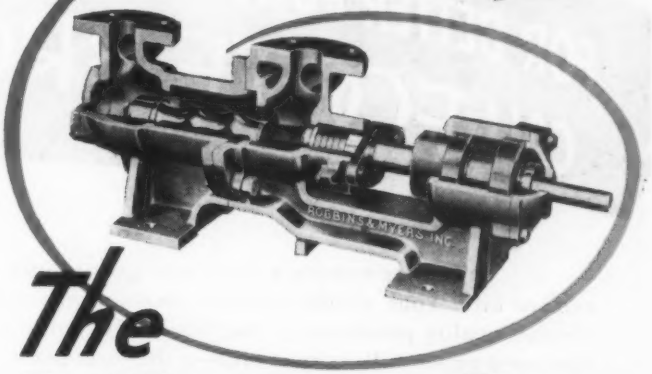
Portable distillation units made by Cleaver-Brooks Company of Milwaukee daily provide millions of gallons of safe, pure water for our fighting forces in forward areas —and do this important job on twenty-one per cent of the fuel formerly required. Common sea water is converted into crystal-clear distilled water for drinking, cooking, and other purposes, and made so chemically pure that it is fit for submarine storage battery use.

Raw sea water is drawn from a nearby off-shore intake by an R & M Moyno pump, belt-driven from the single power shaft that operates the entire unit. Pumping even fresh, clean water is not always the simple service it may seem, but when human lives depend upon pumping *sand-laden salt water,* you need a pump that will stand up and deliver *without faltering.*

Proved in Industry for Use around the World

Licking tough pumping problems is an old story for the R & M Moyno. It will pump practically anything that flows through a pipe, even semi-fluids containing as high as sixty-five per cent solids in suspension; and will handle abrasives and relatively large particles.

The Moyno has no valves; needs no priming; provides high reserve pressure; keeps velocities low, smooth, and uniform; cuts pumping costs on every type of service. Whatever your pumping problem, it will pay you to investigate the astounding performance, durability, and low-cost operation of R & M Moyno pumps.
Send for literature, today.



The R&M MOYNO Pump

The R & M Moyno is unlike any other type of pump, yet it combines the advantages of all in one simple, versatile design. Assembly variations permit combinations which meet unusual pumping needs exactly. Standard models include types for normal uses; higher pressures; volatile liquids; and foods. All are built for positive performance at high efficiency, and for long life with minimum upkeep.

ONLY ONE MOVING PART

The only moving part—a single-thread rotor—revolves within a double-thread helical stator to impart a pumping action comparable to that of a piston moving through a cylinder of infinite length. Discharge is smooth, uniform, and without high turbulence.

LOW UPKEEP

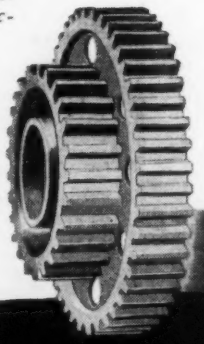
Remarkable endurance is combined with ease of replacement. Wear is confined to the durable rotor and stator, both of which may be easily renewed to restore original efficiency without renewing the housing.

ROBBINS & MYERS • INC. MOYNO PUMP DIVISION • SPRINGFIELD, OHIO
In Canada: Robbins & Myers Co. of Canada, Ltd., Brantford, Ont.

MOTORS · HOISTS · CRANES · MACHINE DRIVES · FANS · MOYNO PUMPS · FOUNDED 1878

Gears as large as this giant or as small as you wish—produced individually or on a production basis.

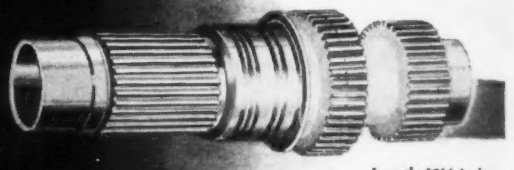
Diameter: 17½ Feet



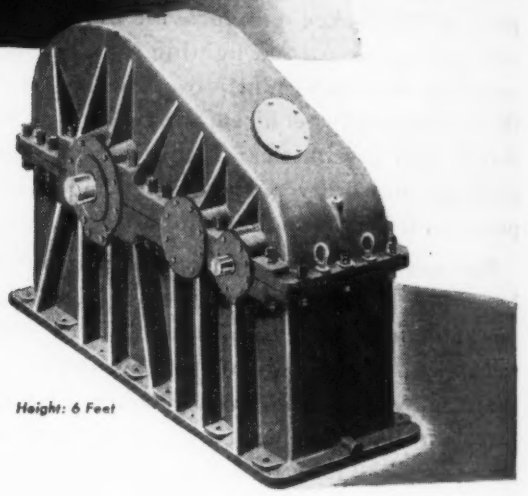
Diameter: 5 Inches

"Aircraft Quality" Gears can give you higher speeds, lighter weight, less noise and greater efficiency.

FOR BETTER POWER TRANSMISSION CALL FOOTE BROS.



Length: 10½ Inches



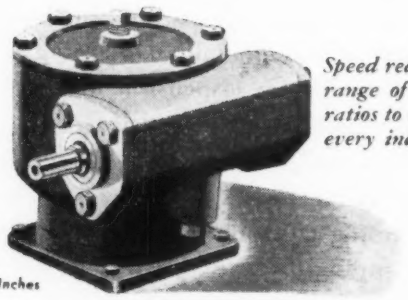
Height: 6 Feet

You may require a giant spur gear to turn a cement kiln. Your production may demand gears of aircraft quality produced by the thousands. You may operate a paper mill—a steel mill—a chemical plant—where your needs for speed reducers vary from midgets, so small you can lift them with one hand, to giants weighing tons. Or, perhaps, you build aircraft engines where advances in gear engineering and newly developed production techniques have made possible the mass manufacture of gears that closely approach engineering perfection.

No matter what application for power transmission equipment you may have—Foote Bros. can aid you.

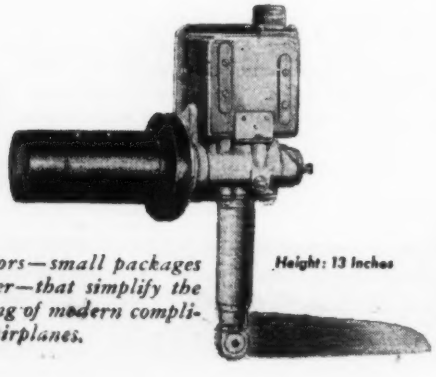
Why not let the years of experience—the vast production facilities—the manufacturing "know-how" of one of America's largest and oldest makers of gears help you solve your power transmission problem?

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. W, 5225 S. Western Boulevard • Chicago 9, Illinois



Speed reducers in a wide range of sizes and gear ratios to meet practically every industrial need.

Height: 5 Inches



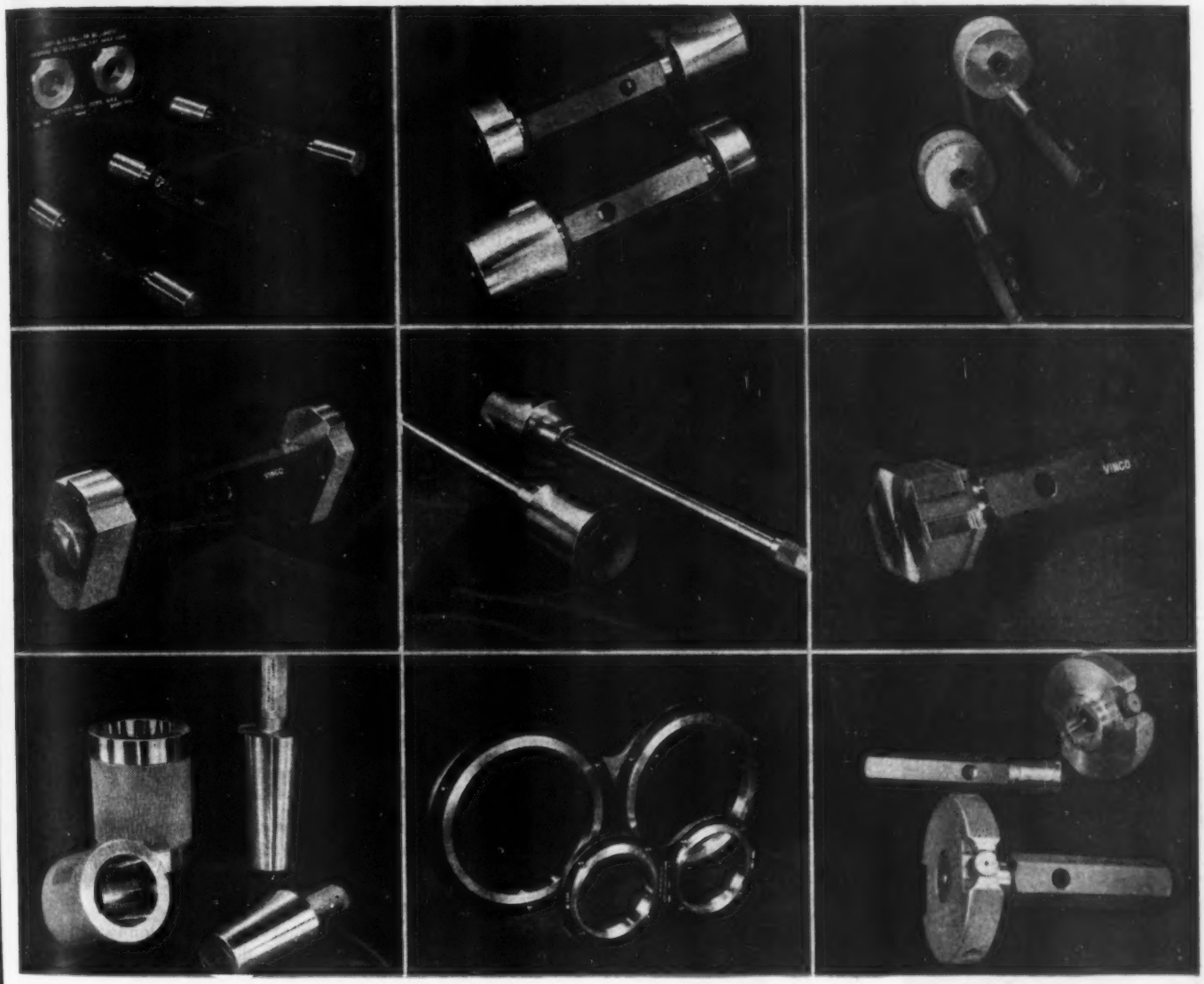
Actuators—small packages of power—that simplify the handling of modern complicated airplanes.

Height: 13 Inches

FOOTE BROS.

Better Power Transmission Through Better Gears

PLAIN GAGES—BUT OF VINCO QUALITY



Simplicity of design plus a great demand have encouraged many gage shops to bid for this type of gage work without having sufficient skill and knowledge to produce the perfection required for constant, accurate gaging. A plain cylindrical gage must not only be accurate but have a hard, durable surface, smooth enough to satisfy the microscopic scrutiny of the surface analyzer. To grind the plug blank down to the required size and still maintain enough lap stock so the minute grind ridges can be lapped to this required smoothness involves a technique that is not learned over-night, a "know-how" that is developed only after long experience. That is the way *WE* make them—so if you are in the market for a plain cylindrical plug that is both durable and accurate, the best suggestion we can make is—Buy VINCO.

VINCO CORPORATION, 8867 SCHAEFER HIGHWAY, DETROIT 27, MICHIGAN. SALES OFFICES: NEW YORK, CHICAGO, CLEVELAND

MILLIONTHS OF AN INCH FOR SALE BY VINCO

REG. U. S. PAT. OFF.

Semi-Automatic Hydraulic Spline and Gear Grinder • Optical Master Inspection Dividing Head • Involute Checker • Angle Tangent to Radius Dresser • Index Plates • Precision Vises • Sine Bars • Straight-side Spline, Serration Spline, Involute Spline and Helical Spline Plug and Ring Gages • Thread Plugs, Rings and Setting Plug Gages • Spur and Helical Master Gears • Munition Gages • Propeller Hub Gages • Built-up and Special Gages • Gear Rolling Fixtures • Spline and Index Fixtures • Hydraulic Power, Control, Utilization and Distribution Units • Engineering, Design and Development.

Quick-As-Wink

HUNT'S *Descaling Valve*

ELIMINATES WATER HAMMER

Design makes the big difference in valves. For instance, with the Quick-As-Wink descaling valve, you have absolute regulation of operating speeds, and can control opening and closing speed independently, eliminating water hammer entirely.

Many customers specify Quick-As-Wink valves exclusively because they prefer the Quick-As-Wink design, performance, and construction.

You will find complete information, including sizes, styles, engineering drawings and data in the C. B. Hunt catalog. Write for your copy.

C. B. HUNT & SON
1850 E. PERSHING STREET
SALEM, OHIO

THE HIGHER THE PRESSURE — AIR WATER OIL — THE TIGHTER THE SEAL

★ ★ ★ ★ ★ ★

PLANS and PLANES DO CHANGE

The progress of war has brought about many changes in specifications for planes and all other machinery of war—but the demand for quality in production persists — the quality that has won acclaim for Diefendorf Gears for many years.

Diefendorf engineers are planning now for tomorrow's civilian goods changes.

Diefendorf Gear Corp.
Syracuse, New York

diefendorf ★ ★ ★ ★ ★ **GEARS**

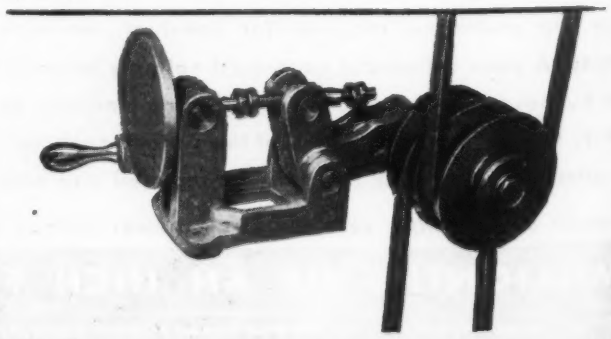
SPEEDMASTER

STEPS UP PRODUCTION

Are your machines set too slow a speed to meet today's production demands? Investigate the Speedmaster, the mode of Variable Speed Control that provides a versatile range of speeds, 6 to 1 ratio.

A turn of the hand wheel changes speeds instantly without work stoppage. Free floating pulley aligns belts automatically and insures long belt life. 3 sizes, 9 different types.

Consult our Engineering Dept. today about adapting Speedmasters to your machines. Ask for interesting Speedmaster manual.



The DoALL COMPANY
227 N. LAUREL AVE., DES PLAINES, ILL.

The ability to take punishment is built into every Ross Air Control Valve. With friction reduced to a minimum . . . with hardened steel used wherever there is a wearing surface . . . with an extra strength factor provided for every stress . . . and with an engineering design of utmost simplicity—Ross valves give long years of useful life. Many built more than 20 years ago are still in active service.

Representatives in Principal Centers

ROSS *Operating* VALVE CO.

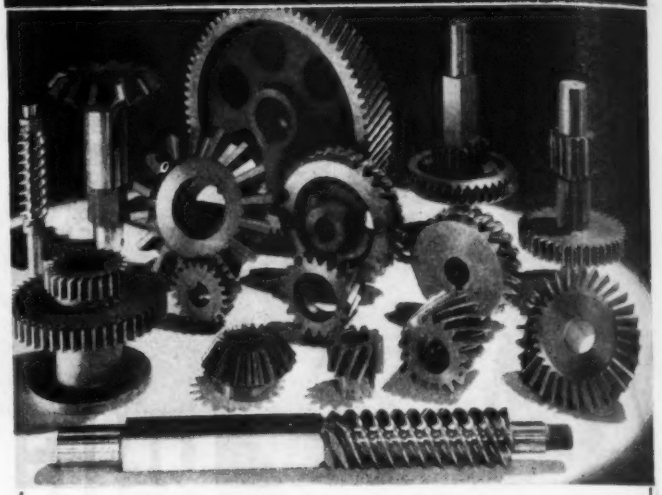
6495 Epworth Blvd. Detroit 10, Mich.

The world-wide reputation Briggs & Stratton has earned as manufacturers of "*the world's finest gasoline engines*" was born of constant research in our plant and afield — constantly adding improvements and refinements — developing advancements in design and engineering — and ever-increasing precision manufacture.

Air-Cooled Power 4 CYCLE BRIGGS & STRATTON GASOLINE ENGINES

Always striving for and building for the best in *air-cooled power* — quick starting, dependable and economical — insuring trouble-free performance — has resulted in a demand for *more than two million* Briggs & Stratton engines — during 25 years of *continuous production*. BRIGGS & STRATTON CORPORATION, Milwaukee 1, Wisconsin, U. S. A.

Helping to Move the Services
Abart GEARS



Abart Gears for war production. Abart Gears for war machinery in the air, on land, and sea, and undersea. The call is unceasing!

LET US KNOW YOUR REQUIREMENTS

Spur, bevel, helical, internal, small or large. All materials. Abart will go into earliest possible production and delivery for *you*. No stocks. Send specifications.

SPEED REDUCERS: Over 75 types and sizes. Ask for catalog.

Abart GEAR AND MACHINE CO.
MANUFACTURERS OF
Speed Reducers & Gears
4840 WEST 16TH ST., CHICAGO 50, ILLINOIS

A 2-POINT SERVICE FOR YOUR POST-WAR HYDRAULIC NEEDS

by ADECO...
SPECIALISTS IN HYDRAULICS

In lining up your post-war schedules, it will pay you to utilize Adeco experience and facilities. These specialists in hydraulics can help you in two important ways:

1. Assist you in designing hydraulic mechanisms to meet your requirements.
2. Work with you in producing precision parts and assemblies on a contract basis.

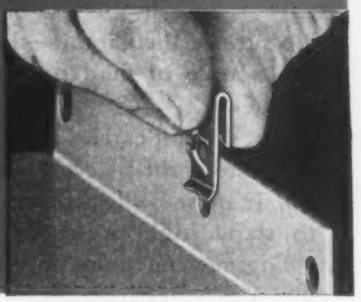
An illustrated booklet presents the story behind this Adeco service. Write for your copy today.

ADECO
AIRCRAFT AND DIESEL EQUIPMENT CORP.
4403 NORTH RAVENSWOOD AVENUE, CHICAGO 40, ILL.
YOUR PARTNERS IN PRECISION

ONE OF A SERIES PORTRAYING THE "SPEED NUT FAMILY OF FASTENINGS"

"J" TYPE SPEED NUT

Self-Retaining for BLIND LOCATION ASSEMBLY



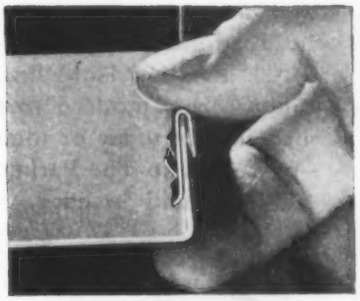
Positioning "J" nut over hole in flange.

● Another exclusive SPEED NUT design to simplify and speed up blind location assembly. The "J" nut is attached by hand and *holds itself in place*, thus eliminating the necessity of welding, riveting, or staking ordinary fasteners.

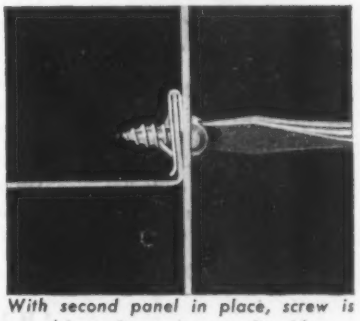
These spring steel SPEED NUTS are pressed over holes along edge of panels or flanges. An extrusion in lower leg of "J" nut *snaps* into hole to retain nut in perfect register. By increasing diameter of hole, any degree of "float" may be obtained, to compensate for misalignment.

The sturdy arched prongs of the "J" nut possess surprising holding power. They eliminate vibration loosening by *absorbing vibration*, yet are sufficiently resilient to prevent damage to enamel, plastic or glass.

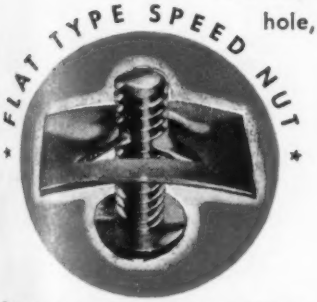
"J" type SPEED NUTS will improve your postwar products, speed up assembly, and reduce costs. Send in your assembly details today and we'll gladly rush samples.



As nut is pressed on, extrusion on lower leg snaps into hole.



With second panel in place, screw is driven. Access to opposite side ★ unnecessary.



THE BASIC PRINCIPLE of Spring-Tension Lock is Embodied in all Speed Nut Designs

TINNERMAN PRODUCTS, INC.
2041 Fulton Road · Cleveland 13, Ohio
In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario
In England: Simmonds Aerocessories, Ltd., London

Speed Nuts* PATENTED *Trade Mark Reg. U. S. Pat. Off

FASTEST THING IN FASTENINGS

THE EFFECTIVENESS OF

fluid power

DEPENDS ON

THIS

VITAL LINK

ENGINEERED BY **parker**

Be sure of the Circuit—the "vital link" between the source of fluid power and the device that applies it.

The Circuit carries fluid power around corners and into tight places—wherever you want it to go. It must be leakproof, vibration-proof, able to stand high pressures and resist corrosion.

Engineering fluid power circuits is a Parker job. Years of experience have showed us how to design them, how to build the necessary valves and fittings and how to plan sure-working installations.

Ask a Parker Fluid Power Engineer how you can use this modern form of power on your machines of today or tomorrow. No obligation —just write to The Parker Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio.

THE PARKER COUPLING is the key to the vital link, engineered and designed by Parker—protected against leakage and vibration, precision-made, quick to install, quick to service.

A. A. F. SURPLUS WAR STOCKS OF VALVES AND FITTINGS

Parker has been selected to distribute large A. A. F. Surplus War Stocks of Valves and Fittings. Immediate deliveries. For information, specifications, prices and installation help, phone, wire or write Parker Service Agency, a Parker subsidiary and agent for Metals Reserve Co., 17325 Euclid Avenue, Cleveland 12, Ohio.

THE

PARKER

APPLIANCE COMPANY

CLEVELAND • LOS ANGELES

FLUID POWER ENGINEERING

A WIDE RANGE of MOTOR DRIVEN CENTRIFUGALS

For Varied Requirements

- Several styles for varying depths of submergence with capacities up to 70 gals. per min. at 8 ft. head. (Style shown is No. 206.)
- Styles with motors having integral mounting brackets. Compact. Flexible. Piped intake.
- Styles with integral flange mountings which serve as intake. (Piping not required.)

This complete range meets most requirements. Catalog sent on request. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

B·S

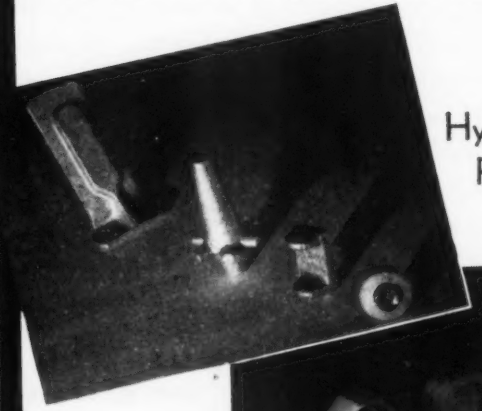
GEARED — VANE — CENTRIFUGAL — MOTOR DRIVEN

BROWN & SHARPE PUMPS

DRESSER FORGINGS

Dresser prompt service frequently saves customers "down time". Delivery promises are reliable, and over fifty years' production experience enables us to do precision forging work.

Include machining with your inquiry.

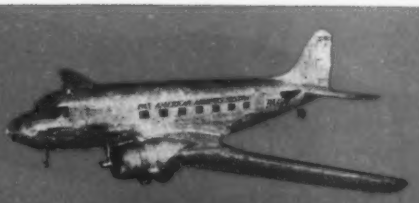


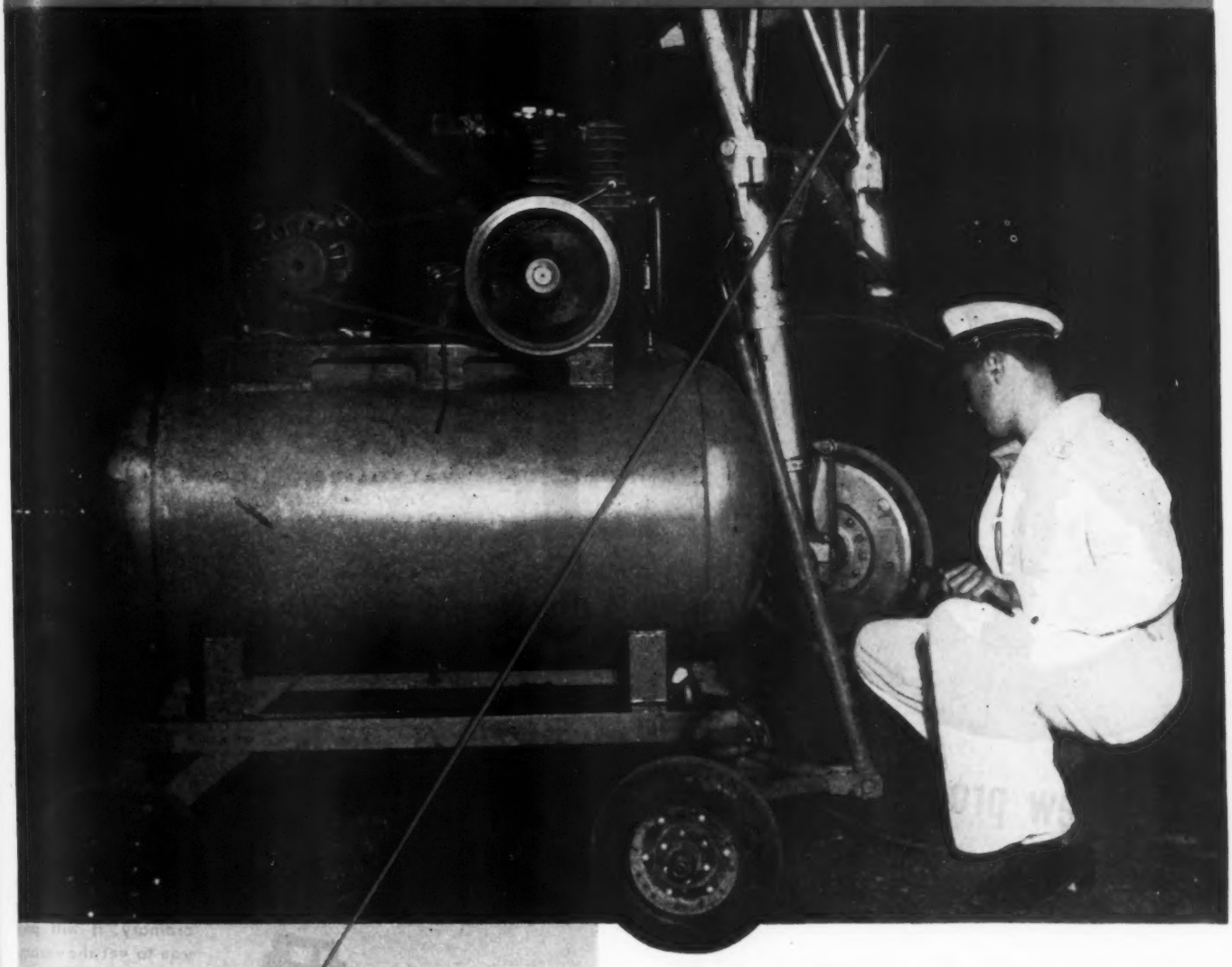
Hydraulic Press

Upsetter

DRESSER MANUFACTURING CO.
BRADFORD, PA.

Scaife Air Tanks





help service America's Clipper Ships at home and abroad

Among many time-saving devices used by Pan-American Airways is the mobile compressed air outfit illustrated above—equipped with a Scaife air-receiver.

If your present or future plans call for the use of cylindrical products or containers for gases, air, water and other liquids, we will be glad to show you how our experience with products of this type may be of real help to you.

SCAIFE COMPANY

FOUNDED 1802

OAKMONT (Pittsburgh District), PA.

Representatives in Principal Cities

but new products need new *FASTENINGS*

When America settles down to peace, pre-war performance will be as obsolete as pre-war design. For war has taught us that efficiency starts with production and carries on throughout the life of the product.

Fastenings are a major item in manufacture and service. With the aeroplane they mean securely tight doors and access panels at 400 miles per hour—yet instantly removable for servicing. Camloc solved this problem with millions of fasteners on fighting duty all over the world. Camloc engineers would like an opportunity to design efficient, economical fasteners that will be worthy of your new products.

CAMLOC

CAMLOC FASTENER CORPORATION

© Camloc Fastener Corp.

420 LEXINGTON AVENUE, NEW YORK 17, N. Y.

TECTYL *helped to salvage the Squalus*

The hull and engines of the submarine Squalus, long immersed in sea water, were flushed with Tectyl 511, which pushes every trace of water off of metal and SEALS the surface against rust and corrosion. One of the five specialized types of Tectyl will solve your own special rust-prevention problem. Easy to apply and remove, economical to use—Tectyl protection is *positive*. Write now, indicating your corrosion problem, and we will send you Tectyl bulletin with complete application data.

TECTYL *STOPS RUST*

VALVOLINE OIL COMPANY

Finest Lubricating Oils Since 1866

471 Culvert Street Cincinnati 2, Ohio

Refinery at Butler, Penn. General Offices, Cincinnati Ohio

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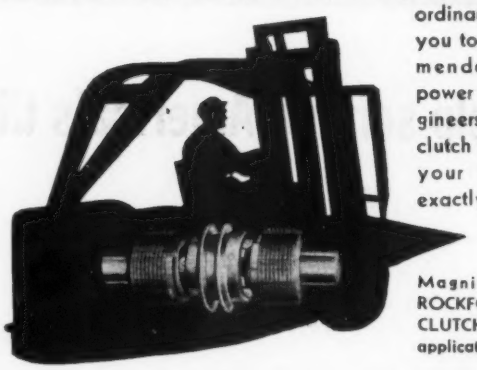
Vancouver - Washington, D. C.

E-N-G-I-N-E-E-R-E-D

To Fit YOUR Product

For over a quarter century we have been making clutches of all kinds. This clutch building experience has developed a specialized engineering service of value to manufacturers whose product designs require special clutch applications. It is a good idea to use standard clutches, where practical, but if your need is out of the ordinary, it will pay you to get the recommendations of our power transmission engineers regarding the clutch which will meet your specifications exactly.



Magnified view of a ROCKFORD PULLMORE CLUTCH used in a lift truck application.

SEND FOR THIS HANDY BULLETIN ON POWER TRANSMISSON

Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications. Every production engineer will find help in this handy bulletin, when planning postwar products.

Rockford Drilling Machine Division

Borg-Warner Corporation

209 Catherine Street, Rockford, Illinois, U.S.A.

ROCKFORD CLUTCHES

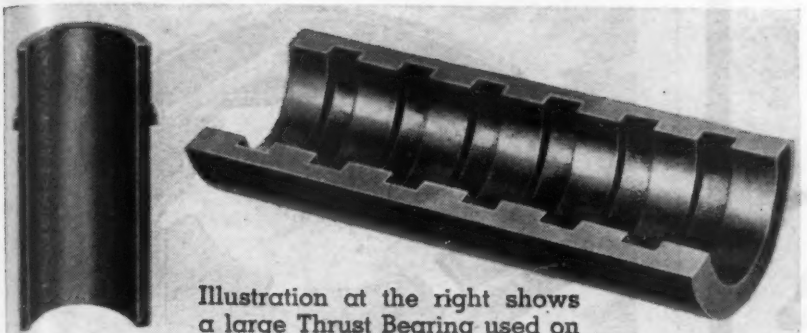


Illustration at the right shows a large Thrust Bearing used on Jordan Engines in Paper Mills.

Gatke BEARINGS Do the Impossible

GATKE Bearings are moulded to machined accuracy in all shapes and sizes for replacing metal bearings without change in standards. They are engineered for the application and made of service-proved materials of proper characteristics for the job. Furnished in three general types—LUBRITEX for oil or grease lubrication, HYDROTEX for water lubrication, and GRAFITEX for some self-lubricated applications.

On tough jobs throughout all industry GATKE Bearings give results so superior to metal bearings there's no comparison. Here's why—

RESILIENCE to absorb shock and protect journals, yet resume normal shape under repeated shocks and blows that "pound out" and crystalize metal bearings.

OIL and GREASE RETAINING QUALITIES that maintain lubrication under heavy loads even at a standstill. *Starting friction with grease lubrication is 50% less than grease-lubricated metal bearings.* Unequalled for oscillating journals or where oil and grease must be kept to a minimum.

DO NOT SCORE JOURNALS. Even if lubrication fails for limited periods, journals are not harmed.

LOWEST FRICTION. With water lubrication friction is 65% less than grease-lubricated bronze.

TREMENDOUS WEAR LIFE. On severe service 20 times the life of bronze bearings is not uncommon.

LIGHT WEIGHT. 80 to 85% less than bronze.

GATKE Bearings have many other qualities every manufacturer, designer and user of equipment should know about.

Write for literature.

GATKE CORPORATION

250 N. La Salle St., Chicago 1, Ill.

PERFORMANCE INSURANCE...

When your design calls for air cylinders, air chucks, or any other air-actuated mechanism—*take one more important step!* Insure better performance and longer service by installing a Norgren Lubro-Control Unit.

WHAT IT IS:

The Norgren LUBRO-CONTROL Unit consists of (1) Filter, (2) Pressure Reducing Valve, (3) Lubricator. It is compact: less than a foot long. Size for every need. Each member may be used separately.

WHAT IT DOES:

(1) Filters dust, rust, and emulsions out of the air; (2) Regulates pressures automatically; (3) Lubricates every moving part of air-driven device by injecting an oil-air fog into the air stream. Automatic: start and stop with the air flow. Sight feed.

CATALOG 400 shows many typical applications. More than 165,000 "Norgrens" in use thruout industry. Write C. A. Norgen Company, 220 Santa Fe Drive, Denver 9, Colorado.

Norgren

ONE PALNUT replaces a regular Nut and Lockwasher

Provides unfailing security with Savings in Time, Cost, Weight, Space

Years of successful use on Radio, Electrical and Mechanical equipment have proved that the double-locking action* of PALNUTS holds tight under vibration, eliminating need for slower, heavier, more expensive nut-and-lockwasher assemblies.

With this dependable security of PALNUTS, you also cut the cost of fastenings in half—reduce assembly time 50%—save up to 90% in weight—require less space.

PALNUTS are single thread locknuts, made of spring tempered steel. Speedily applied with Yankee or Power Drivers. Available in a wide range of types, sizes and finishes.

DOUBLE-LOCKING ACTION

When the Palnut is tightened, its arched, slotted jaws grip the bolt like a chuck (B-B), while spring tension is exerted upward on the bolt thread and downward on the part (A-A), securely locking both.

Send details of your assembly for samples. Write for Palnut Manual No. 2 giving complete engineering data.

THE PALNUT COMPANY
65 Cordier Street,
Irvington, 11, N. J.

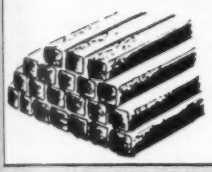
SELF-LOCKING
PALNUTS

FORGINGS POSSESS HIGH STRENGTH and TOUGHNESS

• Forging, or hot working metal, with closed impression dies directions the fiber structure, inherent in steel, to provide high strength and toughness where most needed to resist stress or shock. Maximum strength for a given amount of weight is just one of seven advantages that forgings offer.

These Are Other Advantages:

FORGINGS CONSERVE METAL

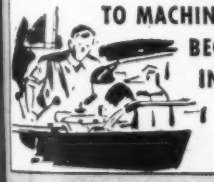


FORGINGS LESSEN SCRAP; UNUSUALLY FREE OF CONCEALED DEFECTS; PRACTICALLY NO REJECTIONS

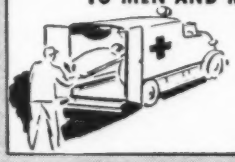
FORGINGS REDUCE DEAD WEIGHT THROUGH MAXIMUM STRENGTH IN LIGHTER SECTIONAL THICKNESSES

FORGINGS FACILITATE RAPID ASSEMBLY THROUGH WELDING ADAPTABILITY

FORGINGS REQUIRE LESS TIME TO MACHINE AND FINISH BECAUSE SHAPED IN CLOSED DIES



FORGINGS REDUCE ACCIDENTS TO MEN AND MACHINES THROUGH A GREATER MARGIN OF SAFETY



Are you obtaining the utmost benefit from your use of forgings? A recheck of every forged part you use against these advantages may reveal unusual benefits which have been unintentionally neglected or overlooked. Even manufacturers who have had long experience in the use of forgings have found further opportunities to *reduce weight, improve product performance and effect worth-while savings* by rechecking parts against these advantages. • Consult a forging engineer connected with your source of supply. His broad experience will be helpful to you in obtaining the utmost benefit from each advantage in your use of forgings.

This new booklet will help you to avoid misestimating the qualities required to meet a specific service condition. Metal quality can be developed to the exact degree required by the forging process, and this booklet presents many examples that prove it. It contains 40 pages of factual information about the development of maximum strength and toughness in forgings. Over 200 illustrations are used, most of them for the purpose of showing directioned fibre structure, or grain flow as obtained by forging. This booklet has been prepared for the guidance of design engineers, metallurgists, and other technicians, production and management executives; whose task it is to determine the metal quality required for *safety and dependable performance.* Ask your source for forgings for a copy, or write direct.

Drop Forging Topics contains technical information for design engineers, production executives, metallurgists, and other technicians who specify and use metal parts for operating mechanisms. It is published ten times a year; usually contains 8 pages and is available upon request. Is your name on *Topics* mailing list?

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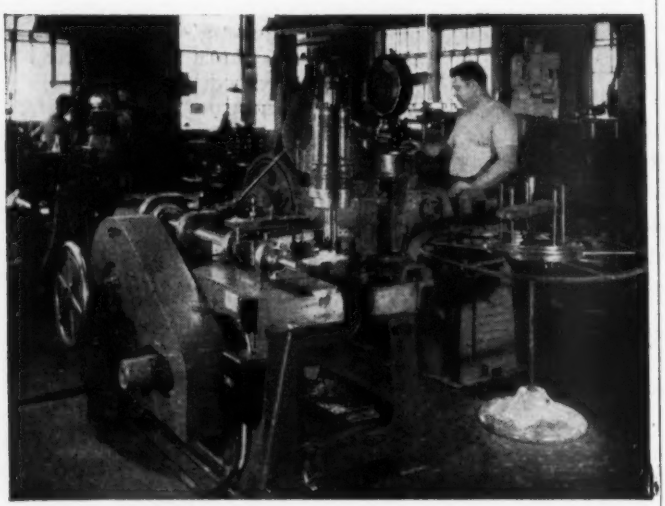
Get this Book on Reliable Springs

Reliable

If you make a product requiring springs, you will be interested in having this Reliable Spring Catalog. It shows hundreds of typical and special springs (round or square wire .006 to .375 diameter, or strip of .003 to .187 thickness) also clips, stampings and wire forms, which we are equipped to produce. It also contains helpful charts furnishing to spring designers the relationship of dimensions, load, travel distance, number of coils, and wire size.

Reliable is fully experienced in making precision springs to extremely close tolerances—and when it comes to *customer cooperation*, Reliable is almost in a class by itself.

This Catalog 44 will be promptly sent to you on request.



Our shop equipment is modern and efficient.

THE RELIABLE SPRING & WIRE FORMS CO.

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YOU CAN RELY ON

Reliable Springs

ROUND AND FLAT WIRE SPRINGS · CLIPS · HOOKS · BENDS · LIGHT STAMPINGS

ROPER Rotary Pumps

DEPENDABLE SINCE 1857

The Simplest of All Pump Designs Assures Longer Trouble-free Service

The simplest design ever conceived has made Roper the outstanding pump for efficient, dependable performance. In a Roper there are only 2 moving parts . . . equal-size pumping gears that "float" in operation with wear-free clearance. Fewer parts and time-tested construction enable Ropers to withstand heavier operating loads, give longer service, deliver a strong, pulsation-free flow.

Sturdy and compact, Ropers require less space and permit periodic inspection of internal parts without disturbing piping or power units.

You can rely on a Roper for the most productive, economical service any pump can render.

Competent engineering and consultation service is at your disposal.

Send for Bulletin 147

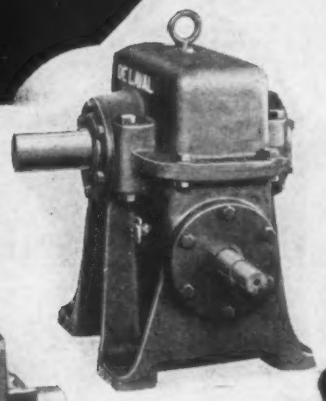
A summary and digest of factual information concerning pumps and pumping problems.

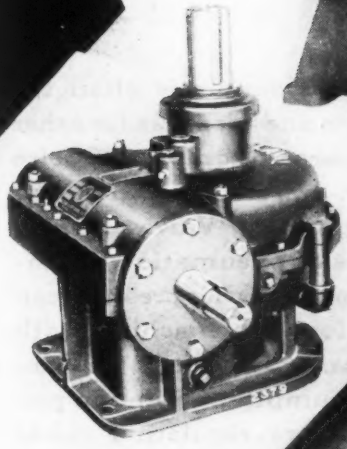
GEO. D. ROPER CORPORATION

ROCKFORD, ILLINOIS

ALSO BUILDERS OF AMERICA'S FINEST GAS RANGE

LET DE LAVAL HELP YOU SELECT THE *correct* WORM GEAR





Too large a worm gear is unnecessarily expensive; too small a gear invites failure. Correct selection depends not only upon transmitted horsepower and ratio of reduction but also upon continuity of operation, shock and other load characteristics. The recommendations of the De Laval representative assure you of the right drive at the right price. He is backed by Home Office engineering experience, gained in furnishing worm gear drives for all classes of service over the last twenty years.

Specifications alone do not make a worm gear

1144

TURBINES • HELICAL GEARS and WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

WORM GEAR DIVISION

DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

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Combines all significant lock-nut **advantages!**

READ THE STORY of this advanced nut locking principle. • An-cor-lox lock nuts (patented) are helping many a wartime production, service and maintenance job. • Locking security; quick, simple installation; wide adaptability; An-cor-lox provides them all.

Write for the An-cor-lox bulletin —and your An-cor-lox sample. Demonstrate for yourself.

An-cor-lox
TRADE-MARK REG
Lock Nuts

An-cor-lox Division
LAMINATED SHIM COMPANY
Incorporated
63 Union Street • Glenbrook, Conn.

1877

NEITHER FEAST NOR FAMINE

Unregulated air supply is often too much for some and too little for other types of air operated equipment. Solve this problem by choosing Hannifin Pressure Regulating Valves for use with any type of pneumatic machinery. The correct working pressure can be provided for each machine, with easier and safer handling, and reduced air consumption. Hannifin piston type pressure regulating valves are instantly adjustable, accurate and dependable. Simple construction means long, reliable performance without maintenance. Three standard sizes, ⅜, ½ and ¾ inch, for use on initial pressure up to 150 lbs. Write for Bulletin 56. Hannifin Manufacturing Company, 621-631 South Kolmar Ave., Chicago 24, Illinois.

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PRESSURE REGULATING VALVES

What do you mean, PULL* *riveting?*

Cherry Rivets are used for all blind riveting. But a lot of smart producers —designers, engineers, manufacturers— are using these extremely versatile and easy-to-use rivets on jobs that are not blind at all. Cherry Rivets make production jobs possible with little or no tooling or special set-up. Cherry Rivets can be used in soft or brittle materials that ordinarily can't be riveted at all. Cherry Rivets make most any job a better looking job even in hard-to-get-at places. It's all due to the Cherry method of upsetting—a pull instead of a pound.

CHERRY RIVETS, THEIR MANUFACTURE AND APPLICATION ARE COVERED BY U. S. PATENTS ISSUED AND PENDING

Cherry Rivet *Company*
LOS ANGELES, CALIFORNIA

If you think it sounds impossible read this book. Ask for Handbook No. A-43. Write to Department A-106, Cherry Rivet Company, 231 Winston Street, Los Angeles 13, California.

*Cherry Riveting—with a pull instead of a pound.

New! STRONGHOLD SCREW PRODUCTS

HEX-SCRO

An Improved "STRONGHOLD" Multi-Use Multi-Drive Fastener

NO SPECIAL TOOLS REQUIRED

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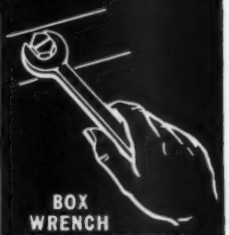
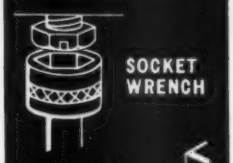
A SLEEK new product that has many outstanding mechanical and use advantages over ordinary machine screws—little brother to the matchless STRONGHOLD cap screw.

- Cold forged, free from internal stress and strain.
- Thread points are machine chamfered for easy starting.
- Heads are trimmed to close tolerances; sharp corners of heads assure longer tool life.
- Heads chamfered with washer face underneath.
- Ideally suited for power or hand tool application; can be driven at any driving angle without damage to screw head.
- Will stand tremendous amount of driving torque without damage to head.
- Easily accessible from either top or side in hard-to-reach places.
- Machine screws and set screws made in lengths from ¼" to 1½"; diameters, No. 6, 8, 10, 12; coarse or fine thread.

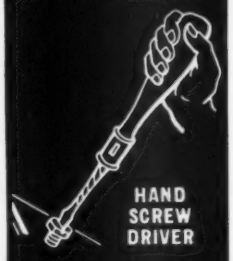


BOX WRENCH OR OPEN WRENCH

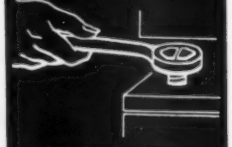


SOCKET WRENCH

POWER SCREW DRIVER



HAND SCREW DRIVER



HARD-TO-REACH PLACES EASILY ACCESSIBLE

Ask for Free Samples

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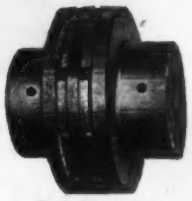
WHETHER YOU REQUIRE COUPLINGS FOR THE . . .

Light Duties
OR THE
HEAVIEST DUTIES



L-R Type "W"
Pat. & Pats. Pend.

For steel, rubber and cement mills, excavating, and many other services. Bores 1¼" to 16¾". Approximate weights from 9 to 3,000 lbs. For duties from 2 to 2,500 h.p. at 100 r.p.m. Individual free - floating load cushions of material adapted to services.

L-R Type "IA"
Pat. & Pats. Pend.

For duties from 1/6 to 50 h.p., L-R Type "IA" has long held outstanding pre-eminence. It is for the most widely used of all couplings. For fan and air-conditioning, small pumps, fractional h.p. motors, a multitude of uses. Only 3 parts, 2 metal jaws and resilient spider.

There's an L-R Coupling exactly suited to your duty and *kind* of service.

•

L-R FLEXIBLE COUPLINGS

L-R *"Resilient Alignment"* Couplings with free-floating cushions hung between rugged metal jaws, are free to adjust instantly to every emergency—for correction of misalignment, absorption of surge, shock, and vibration, as well as wear on bearings, etc. Internal friction is eliminated. Couplings are extremely free from noise. Cushions always in plain sight for inspection. NO SHUT-DOWNS NECESSARY FOR CHANGING. No lubrication *ever* required.

***Send for* COMPLETE CATALOG and QUICK-FINDING SELECTOR CHARTS**

★

These handy Charts enable you to find couplings you are looking for without tedious figuring. Special couplings engineered.

WIRE OR WRITE

Lovejoy Flexible Coupling Co.

5019 W. Lake St. • Chicago 44, Ill.

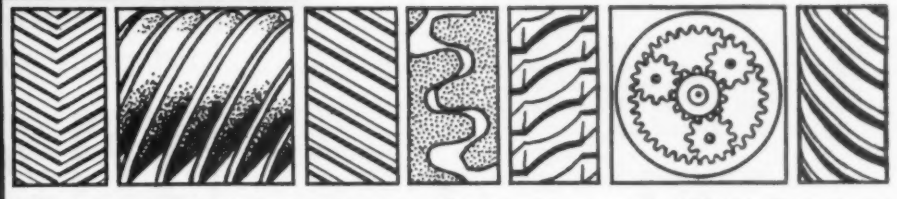
Brad Foote Gears

Large Gears, Small Gears and Those In Between

It's all the same at the ultra-modern Brad Foote Plant, where special precision-cut gears have been made for over a generation.

The extensive equipment of this plant permits the manufacture of unusually large amounts of smooth running quality precision-cut gears in all tooth forms from any practical material.

Brad Foote special cut gears have met the test and are doing their bit.



Brad Foote Precision cut bevel gears

BRAD FOOTE GEAR WORKS

1309 S. CICERO AVENUE CICERO 50, ILLINOIS

Absorbed 578% *of its weight in oil!*

After 24 hours' immersion in S.A.E. 20 oil, wick specimens (each .25″ diam. x 30″ long) of six different types of Booth "prescription" felts were surface-drained and then weighed. Oil absorption as high as 578% of the original weight of specimen was recorded.

Various Booth felt tests, by independent laboratories, may give you new angles on felt. Ask for copies of the reports.

THE BOOTH FELT COMPANY
475 19th Street Brooklyn, N. Y.
736 Sherman Street Chicago, Ill.

APPLICATION CHART AND SAMPLE KIT . . . Contains swatches of S.A.E. felt types, with specification tables. Write for it. (.o sales follow-up.)

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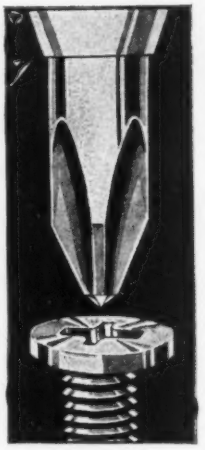
Booth
TRADE MARK

PRECISION CUT FELT PARTS

AVAILABILITY



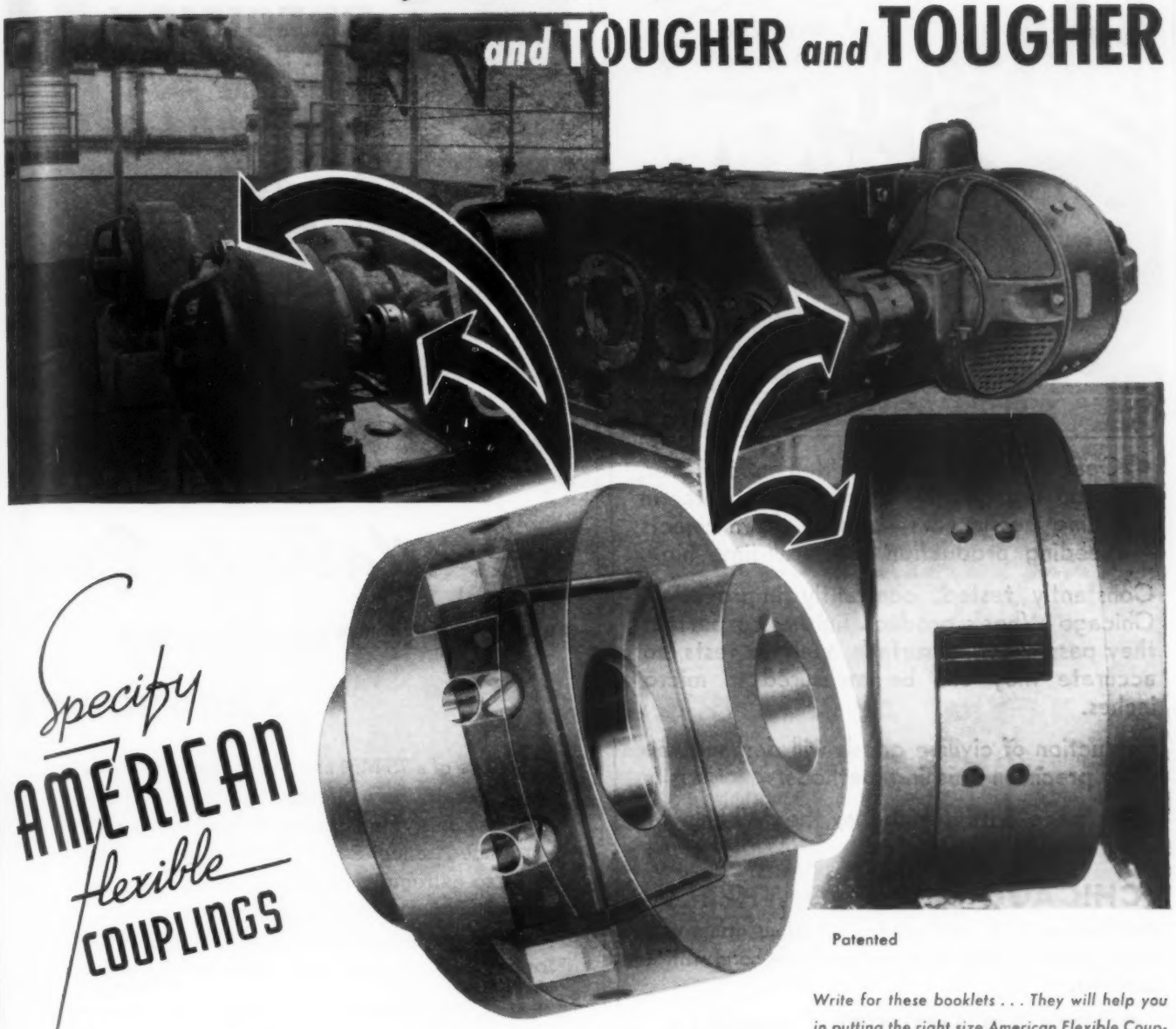
In the switch to peacetime production the availability of materials will engage the interest of designers and production men alike.

Whether it be Rivets, Phillips Recessed Head Screws or other types of fastening devices, MILFORD today is prepared to devote its large and accurate production facilities to supplying your needs. Contact the Milford plant nearest you.

The
MILFORD RIVET & MACHINE CO.

EASTERN DIVISION — CENTRAL DIVISION
MILFORD, CONN. ★ ELYRIA, OHIO.

When the Going Gets TOUGHER
and TOUGHER *and* TOUGHER



Specify AMERICAN *flexible* COUPLINGS

Patented

. . because American Flexible Couplings are meeting all power take-off requirements without friction loss. This maximum power transmission is due to the simple American design . . . ***3 sturdy parts only—2 identical forged or cast jaw flanges connected by a square floating center member of high strength alloyed metals . . . removable bearing strips . . .*** all easily identified in the above phantom view. And for each industrial application you can get the right size American Flexible Coupling. Illustrated above are light, medium and heavy American Flexible Coupling applications.

Write for these booklets . . . They will help you in putting the right size American Flexible Coupling to work on Your Power Take-off Problem.

ZURN

AMERICAN FLEXIBLE COUPLING CO.
DIVISION OF
J. A. ZURN MFG. CO., ERIE, PENNA.

• Geared to the precision demands of war, Chicago Wheels have been a potent force in smashing bottlenecks—cutting down rejects —speeding production to an all-time high.

Constantly tested, constantly improved — Chicago Wheels produce finishes so perfect they pass exacting surface analyzer tests, so accurate they can be measured in micro inches.

Production of civilian goods will demand the same precision finishing methods.

Keep pace with Chicagos, the Wheels of Progress!

CHICAGO GRINDING WHEELS

Anything up to 3" in diameter in various grains and bonds, including FV, the sensational new bond with a pedigree.

CHICAGO MOUNTED WHEELS

Shapes and abrasive formulas to take care of every job of internal or external finishing.

TRY ONE FREE! So you'll know what they can do, we will send a test wheel. Tell us material you'd like to finish and size wheel required.

CHICAGO WHEEL & MFG. CO.

Half a Century of Specialization has Established our Reputation as the Small Wheel People of the Abrasive Industry

1101 W. Monroe St., Dept. PE, Chicago 7, Ill.

PE-1

SEND CATALOG. INTERESTED IN

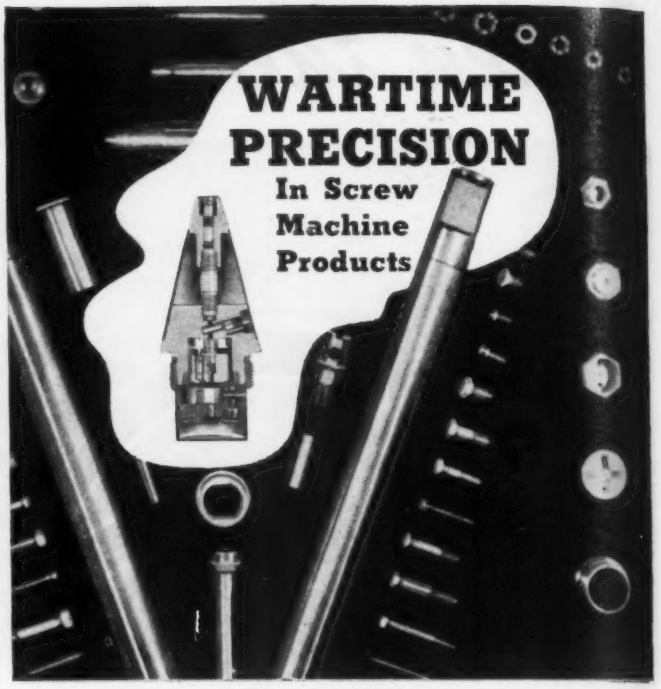
☐ **GRINDING WHEELS**

☐ **MOUNTED WHEELS**

☐ **SEND TEST WHEEL. SIZE.....**

Name.....

Address.....



Available to You

IN YOUR PEACETIME PRODUCTION

The fuze of a 75 MM shell is a typical war product of Federal Screw Works. The parts required in this assembly, in addition to innumerable others produced since Pearl Harbor, are necessarily held to extremely close tolerances. Strict adherence to specified precision limits has become regular procedure in our present manufacturing operations . . . and will continue in the future.

Today, the production facilities of this company are unexcelled in the screw machine industry. The finest equipment for both first and secondary operations is being used. Such operations as cold heading, heat treating, and plating are handled in complete and thoroughly modern departments in the various Federal Screw plants.

The combination of experience, facilities and skilled personnel which Federal Screw can offer may bring to you the right solution to many of your post-war screw machine product problems. Let's talk it over.

Navy "E" Burgee Awarded Jan. 31, '42

Army-Navy "E" Awarded July 29, '42

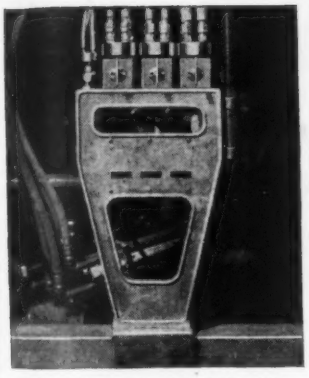
4 Stars Have Since Been Added to the Army-Navy "E" Flag

Federal **SCREW WORKS**

DETROIT AND CHELSEA, MICHIGAN

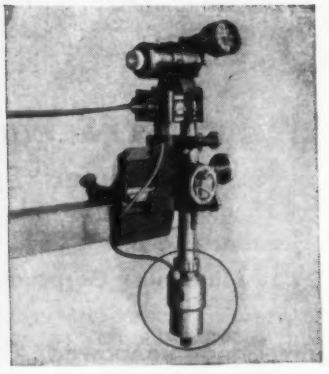
MAIN OFFICES: 3407 Martin Ave., Detroit 10, Michigan

Illustration Courtesy of By-Products Steel Corp., div. of Lukens Steel Co., Coatesville, Pa.



CENTRALIZED GAS CONTROL UNIT

Gives the operator remote control of the pilot light, acetylene, preheating and cutting oxygen from his station at the tracing device.

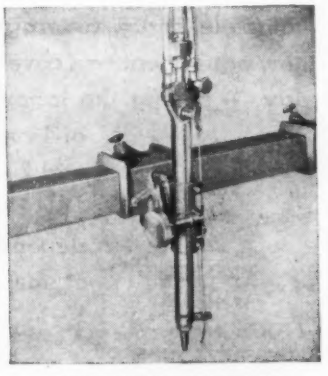


MAGNETIC TRACING DEVICE

An exclusive Airco feature, this device guides cutting torches by automatically following the contour of a steel cam or template.

INDEX SPEED CONTROL

Permits easy, accurate adjustment of torch travel speed during cutting. Speed is visible on the Tachometer attached to the unit.



ADJUSTABLE TORCH HOLDER

Allows torch to be moved easily and locked tightly at any desired position along the bar or tilted up to 45° for bevel cutting.

CUTTING METAL PARTS, CUTTING COSTS

with the

AIRCO No. 6A OXYGRAPH

The motor-driven Airco No. 6A Oxygraph is designed to provide the speed, flexibility and accuracy essential to lowest-cost production of flame-cut steel shapes in any quantity.

It quickly cuts steel plate of light and heavy sections to any shape and size. It can be used for beveling, squaring, straight cutting, stack cutting—changing from one job to another in minimum time—using up to eight torches with standard equipment.

The listing below of some of the plus factors of the No. 6A Oxygraph provides an inkling of its wide acceptance throughout the metal working industry as an important production tool:

1. Extreme accuracy under load—the pantograph design provides maximum resistance to torsion and deflection.
2. The rigid, sturdy base gives trouble-free support to the stout vertical posts and pantograph assembly.
3. Manual, magnetic or spindle type tracing devices can be used.
4. Ball-bearing mounted arms provide uniform, friction-free response to tracing device movement.
5. Centralized gas control unit for individual flame control saves operator's time.
6. Hose or cable lines can't snarl or pinch.

For further details write Department IA, New York Office for Catalog ADC-628—or ask your local Air Reduction office.

AIR REDUCTION

General Offices: 60 East 42nd Street, New York 17, N. Y.

In Texas: Magnolia Airco Gas Products Co. • General Offices - Houston 1, Texas

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AIRCO *Gas Cutting Machines*

A Type and Size for Every Cutting Need

IDEAL TOOLS FOR SPEED, FLEXIBILITY AND ACCURACY IN METAL SHAPING

NEW STEWART-WARNER REPORT ON
ELGIN SAPPHIRE PLUG GAGES:

SAPPHIRE
OUTWEARS STEEL
MORE THAN
350 to 1!

WILL they *never* wear out . . . these Elgin Sapphire Plug Gages in use at a Stewart-Warner plant?

The one which has been used over the longest period has already delivered the incredible total of 110,000 gagings on forged steel parts . . . and still shows no wear! *Steel* plug gages, formerly used on the same kind of parts, averaged only 300 gagings each.

No wear allowance is necessary with Elgin Sapphire Plug Gages. They won't rust, burr or become distorted with use. And ordinary chemicals will not corrode their contact points of sapphire, a material nearly as hard as diamond.

Elgin Sapphire Plug Gages are available in sizes from .040" to .400" and with tolerances as close as .00002". Write for prices and information.

ELGIN SAPPHIRE PRODUCTS PRESENT MANY ADVANTAGES FOR THE FOLLOWING TYPES OF EQUIPMENT:

Ring Gages • Bearings • Thread Guides • Extrusion Dies • Gages • Knife Edges • Spray Nozzles • Diesel Injector Nozzles • Soft Wire Dies • Phonograph Needles • Cutting Tools for soft metals • Burnishing Tools for soft metals • Pressure Vessel Windows • Electrical Insulators • Watch Crystals • Honing Stones.

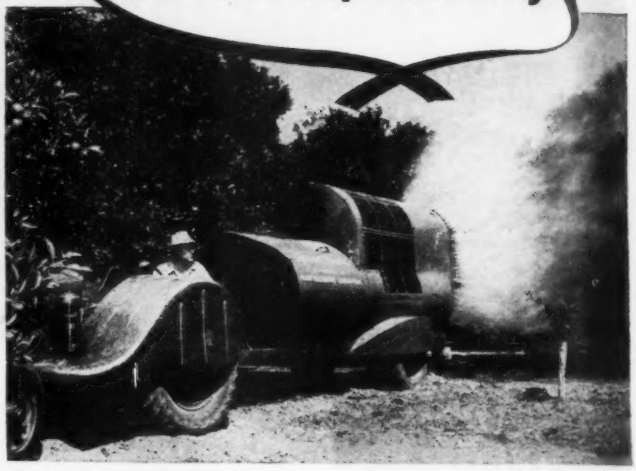
America's best equipped sapphire fabricator

ELGIN NATIONAL WATCH COMPANY

Sapphire Products Division

932 Benton Street, Aurora, Illinois, U. S. A.

WHEELED
by French & Hecht
for
Life-Time Dependability



Another Servant to Progress is Assured Safe Wheeling

The amazing new Speed Sprayer, manufactured by Food Machinery Corporation, brings to fruit growers a new measure of crop protection while saving time and manpower. The Speed Sprayer moves through the orchards throwing germ and insect killing spray into the innermost branches by means of airplane propellers working through a "wind tunnel." In addition to effecting a more uniform and complete spray coverage, it is estimated that this new equipment can cover 30 to 40 acres in an 8-hour day — saving the labor and operating equivalent of 14 men, 3 tractors, 3 spray rigs and 2 supply wagons. The wheels "by French & Hecht" will insure dependable mobility for the life of the equipment.

A SPOKE CAST and PRESSED WHEELS for AGRICULTURE and INDUSTRY

Send Your Wheel Problems To Us

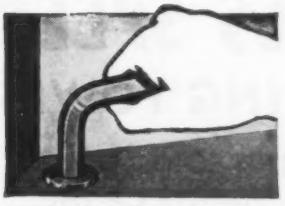
F&H WHEELS ARE IMPORTANT

FRENCH & HECHT, INC.
SUBSIDIARY of KELSEY-HAYES WHEEL CO.
DAVENPORT, IOWA
Wheel Builders Since 1888

HOW NEAR *is*

"JUST AROUND THE CORNER"?

No one knows. The alert manufacturer plans, today, for the arrival of "the corner" by making tests of the parts which will be used eventually in his products, by investigating the better and more advanced methods and processes —yes, he is preparing for the day Post-war production will be an actuality. Design and Production Engineers see a vast, new market opened to them for the fulfillment of their stored-up ideas and creations and they are acting, now, with definite plans for it. Are you?



INTERNAL WRENCHING FEATURE · QUICK & POSITIVE TIGHTENING

SOCKET SCREWS

The BETTER Fastening Method

Solving so-called fastening problems is the work of Holo-Krome Fastening Engineers. Their specialized knowledge and experience is available to your staff of Design and Production men. Schedules are boosted and future plans are formulated after a consultation with them. If your problems are "fastenings," make a date—drop us a line.

CATALOG OF HOLO-KROME PRODUCTS GLADLY SENT.

HOLO-KROME

fibro forged **SOCKET SCREWS**

Manufactured Exclusively by

THE HOLO-KROME SCREW CORP.
HARTFORD 10, CONNECTICUT, U. S. A.

CONTROLS SPEED
BY ABSORBING POWER

THE HYROTARDER IS ONE OF THE MAJOR ADVANCEMENTS OF THE MECHANICAL AGE!

The Parkersburg HYDROTARDER (hydraulic retarder), through its unique means of absorbing power through fluid friction, is applicable to any type of rotating equipment requiring brakes for dissipating power, or for controlling speed by absorbing power. Note below some of the profitable applications now in use.

Speed automatically governed . . . resistance created by fluid friction only . . . just one moving part . . . no mechanical friction or wear . . . does not operate under pressure.

TYPICAL APPLICATIONS:

Dynamometers
Engine Expansion Brakes
Decelleration Brakes
Gravity Conveyor Brakes
Gravity Monitor Brakes
Engine Loading Brakes
Running-In Brakes
Propeller Testing Brakes
Motor Vehicle Brakes

Write us your braking problem, addressing Dept. P

THE PARKERSBURG RIG & REEL COMPANY
Parkersburg, W. Va.

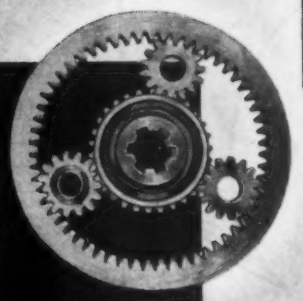
PARKERSBURG
Manufacturers of Quality Products Since 1897

NIBCO WROT *Fittings*

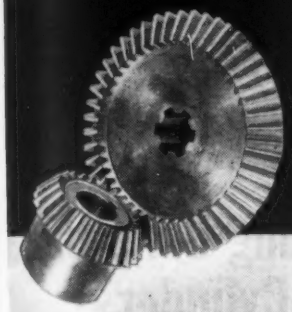
NIBCO WROT Fittings are the answer to the design engineer's prayer. Formed in one step from straight copper, aluminum or stainless steel tubing . . . they are stronger, lighter in weight, more accurately formed and easier to use in production. They are impervious to gases. Close tolerances are maintained by individual plug tests and strict Laboratory Control. NIBCO Return Bends and Industrial Tubular Parts also simplify product design. You can eliminate service troubles by using vibration-proof and corrosion-proof copper tubing with NIBCO WROT Copper Fittings and Valves. Write for complete catalog and get acquainted with the infinite variety of NIBCO products that will simplify your work.

NORTHERN INDIANA BRASS CO.
ELKHART, INDIANA
VALVES AND FITTINGS SINCE 1904

OHIO GEARS *Insure*



PRECISION DRIVE



SPLIT-SECOND REVERSE

in New Cleveland Tapping Machine

• Greater accuracy, at faster production speeds than anything heretofore available mark the new Cleveland Model DB Special Automatic tapping machine.

This high degree of accuracy is attained through precision machining of lead screw ways and through more sensitive spindle and depth controls. Faster production comes through more rapid approach and retraction of the tap plus a unique, split-second reverse. This is accomplished by replacing the reversing motor, ordinarily used on machines of this type, with a planetary gear. Thus the machine is enabled to tap 200% more pieces per hour.

The essential importance of the drive in maintaining this speed and accuracy placed special emphasis on the gears used. Long familiarity with Ohio Gear products and service led to their selection and Cleveland Tapping Co. engineers, in cooperation with Ohio Gear engineers developed the required gearing.

Use of Ohio Gears in this new Cleveland tapping machine is an excellent example of the part Ohio Gear products and engineering are playing in the development of war and postwar products.

THE OHIO GEAR COMPANY
1325 EAST 179th STREET CLEVELAND 10, OHIO

*NEW YORK 13, N. Y.
Patron Transmission Co.
129 Grand Street

NEW ENGLAND
George G. Pragst
P. O. Box 995, Pawtucket, R. I.

*LOS ANGELES, CALIF.
J. W. Minder Chain & Gear Co.
927 Santa Fe Avenue

GRAND RAPIDS 8, MICH.
W. H. Slaughter
3753 Division Ave. S.

*PITTSBURGH, PA.
Standard Machinists Supply Co.
South 2nd and McKean Street

DETROIT 2, MICH.
George P. Coulter
322 Curtiss Building

**Stocks carried.*

*MINNEAPOLIS, MINN.
Industrial Supply Co.
717 S. Eighth Street

BUFFALO 16, N. Y.
F. E. Allen
1315½ Hertel Ave., Room 9

*KANSAS CITY, MO.
Kansas City Rubber & Belting Co.
712 Delaware Street

*SAN FRANCISCO, CALIF.
Adam-Hill Co.
244-246 Ninth St.

LOUISVILLE, KY.
Alfred Halliday, 330 Starks Bldg.

INDIANAPOLIS 4, IND.
A. R. Young
635 N. Pennsylvania St.

ST. LOUIS, MO.
St. Louis Tool Co.
2319 N. Ninth Street

OHIO GEARS

ADD PRESSURE SEAL

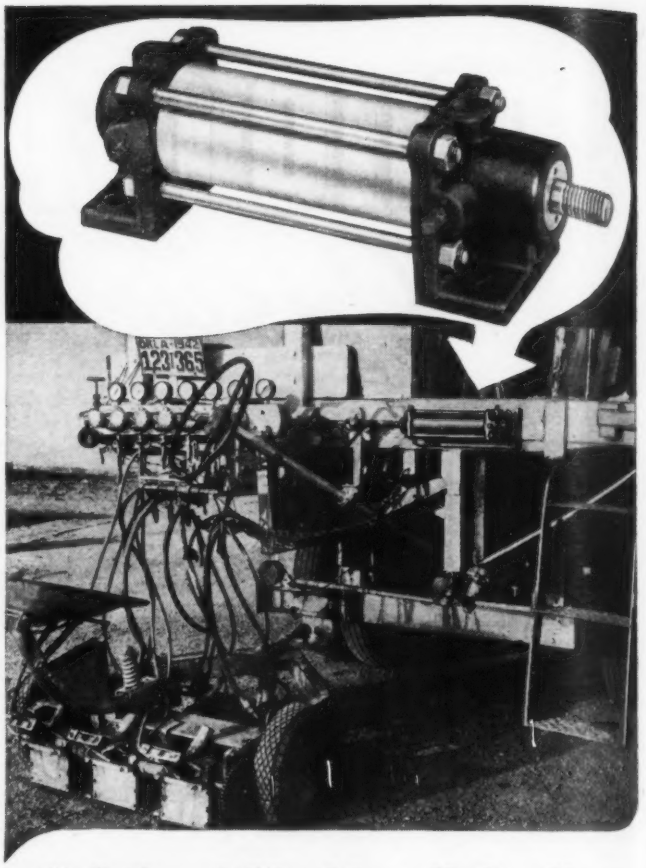
to quicker fit...

THIS MAY BE NEWS to you ... You can get all the advantages of Laminum *plus* the sealing of oil and pressure in bearings ... in *babbitted* Laminum shims. The babbitt lugs are securely locked into the Laminum. Details on request.

Laminum shims are cut to your specifications. For maintenance work, however, shim materials are sold through industrial distributors.

Laminated Shim Company, Incorporated
63 Union Street • Glenbrook, Conn.

LAMINUM
THE SOLID SHIM THAT peels FOR ADJUSTMENT

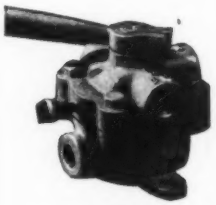


K-C Road Marking Units Use NOPAK Air Cylinders!

This unusual application shows a NOPAK Air Cylinder, mounted on the rear of a motor truck. It emphasizes the fact that cylinder power can be employed successfully on any type of mobile equipment in which compressed air is available.

In this Kelly-Creswell road striping unit, a Standard NOPAK Model A Air Cylinder, controlled by a 3-way hand valve, performs an important lifting and lowering operation. The compressed air is supplied by the same compressor which supplies the spray guns and other air equipment embodied in this unit.

Whether you build stationary or mobile equipment, NOPAK Cylinders of standard design can often provide vital pulling, pushing, lifting or clamping action to eliminate manual effort, speed-up the operating cycle, simplify control. Write for Bulletin 87.



. . . and
NOPAK Valves
are engineered for positive accurate control of air or hydraulic cylinders. Hand, Foot, and Solenoid Models in a complete range of sizes.

GALLAND-HENNING MFG. CO.
2762 S. 31st Street • Milwaukee 7, Wis.

NOPAK *Representatives in Principal Cities*
VALVES and CYLINDERS
DESIGNED for AIR or HYDRAULIC SERVICE

A 4613-½

CLEAR OUT THE "Fastening Bugs" BEFORE YOU SET UP FOR PEACETIME PRODUCTS

Specify the SHORT CUT FASTENING METHOD and avoid later changes, expense, delays

Don't wait until you resume manufacture of your peacetime product to find out that needless tapping, needless inserts in plastics, or other fastening "bugs" are slowing down assemblies and running up your costs.

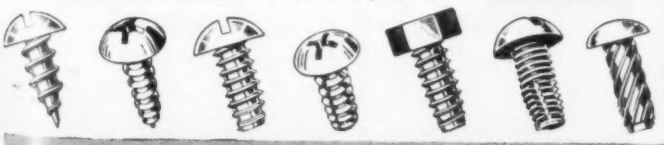
Check up *now*, while your plans are still in process. Choose fastenings as carefully as you settle any other factor of design. Make sure you are using the *short cut fastening method* – Parker-Kalon Self-tapping Screws – wherever possible.

Give your product the advantage of the 30% to 50% saving in assembly time and labor made possible by P-K Self-tapping Screws. Eliminate tapping for machine screws and tap expense – fumbling with nuts and bolts – costly inserts in plastics – riveting in hard-to-reach places.

USER'S GUIDE – FREE! P-K "Users' Guide" describes all types of Parker-Kalon Self-tapping Screws and tells where to use them. Designers and assembly planners need this important information. Write for a copy.

ASK THIS EXPERT ON FASTENINGS

how you can make your product assembly simpler and stronger, how you can save time and lower cost. The P-K Assembly Engineer gives unbiased advice, because P-K makes all types of Self-tapping Screws. He'll call at your request ... or, mail assembly details for recommendations. Parker-Kalon Corporation, 208 Varick Street, New York 14, N. Y.



Will needless tapping and faulty "line-up" slow your assembly?

Here's how Pyrene planned ahead and licked these "bugs"

This well-known maker of fire-fighting equipment, checked fastenings carefully when designing their Phomaire extinguisher. Two fastenings were needed to attach a steel cage to a steel nozzle tube permanently, and P-K Type "U" Screws were chosen for three reasons ...

1. If machine screws were used, tapping would take extra time, and tape breakage would be high because the holes do not always line up exactly. This would also cause difficulty in driving machine screws. Type "U" Screws, however, can be driven into plain drilled holes.

2. A tamper-proof fastening was desired, one that discouraged disassembly. P-K Type "U" Screws made this certain.

3. Because of their simplicity, P-K Screws proved the speediest fastening method, and provided complete security as well.

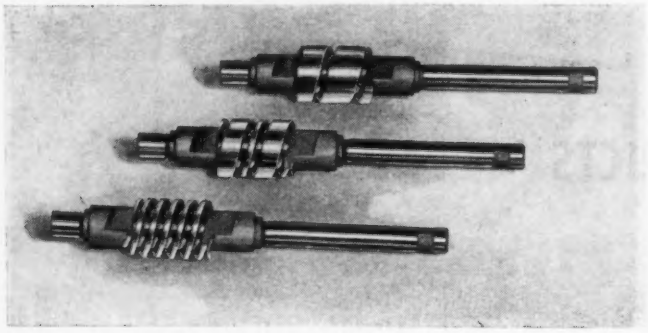
PARKER-KALON
Quality-Controlled
SELF-TAPPING SCREWS

For Every Metal and Plastic Assembly

PRECISION PARTS

WORMS

To Bait the Enemy



The worm as turned.

Precision-machined parts for what it takes to destroy the enemy—Ace is turning them out by the thousands. (Ace has an Axis to grind!) These hardened-steel worm-shafts, for example, are part of vital radio equipment. The triple-lead worm-thread is ground right from the solid blank, after hardening. This insures the concentricity between the pitch-diameter of the worm and the bearing-diameter. The bearing-diameter itself is ground to a total tolerance of .0003″.

Since the war began, Ace has been supplying America's outstanding manufacturers with small parts and assemblies calling for stamping, machining, heat-treating, or grinding. Ace has provided not only the industry's most modern equipment, but the skill, the background, and the ingenuity to use those machines in new ways to improve results, shorten schedules, and get the work out. Keep Ace up your sleeve for post-war plans. Occasional capacity is available for current work.

CURRENT CAPACITY AVAILABLE

CYLINDRICAL GRINDING—Multiple banks of widely varying internal and external cylindrical grinders are available for outside diameters up to 12″ by 24″ between centers . . . and inside diameters as small as 1/16″ or as large as 4″ by 2¼″ long.

THREAD GRINDING—Our battery of Ex-Cell-O Thread Grinders equips us to give you tolerances of .0001″ on all Standard V Threads, Acme and Square Threads, and on single or multiple leads. All sizes up to 5″ diameter with threads 8″ long, on parts up to 20″ between centers.

ACE

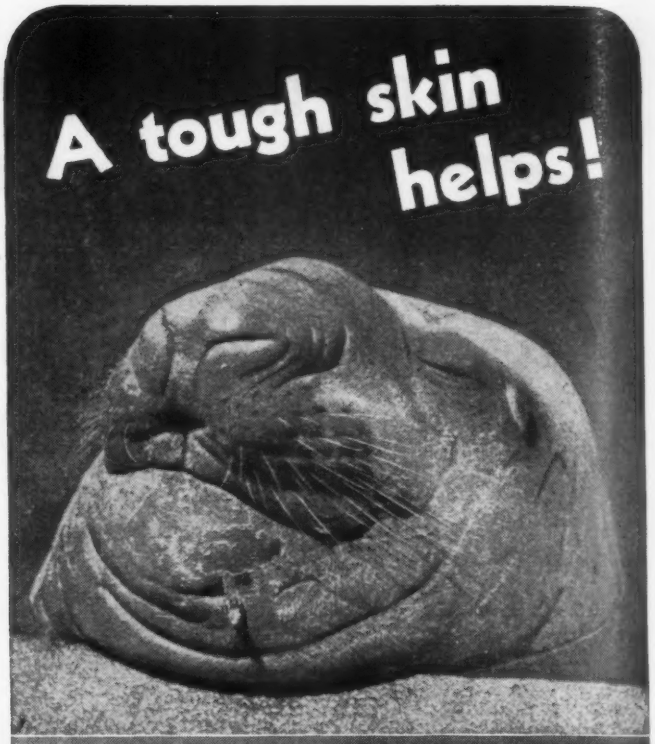
TRADE MARK

ACE MANUFACTURING CORPORATION

for Precision Parts

ARMY E NAVY

1245 E. ERIE AVE., PHILADELPHIA 24, PA.



Special finishes for springs to battle corrosive conditions

Springs that work under severe conditions of corrosion from natural or chemical causes need the extra protection that correct plating can give. Raymond springmakers have developed this phase of service to a high degree—with a Plating Department equipped for many finishes—zinc, cadmium, nickel, copper-dip, Houghto-black. When you buy Raymond Springs, you get complete spring service—with close attention to details that means long life, smooth performance.

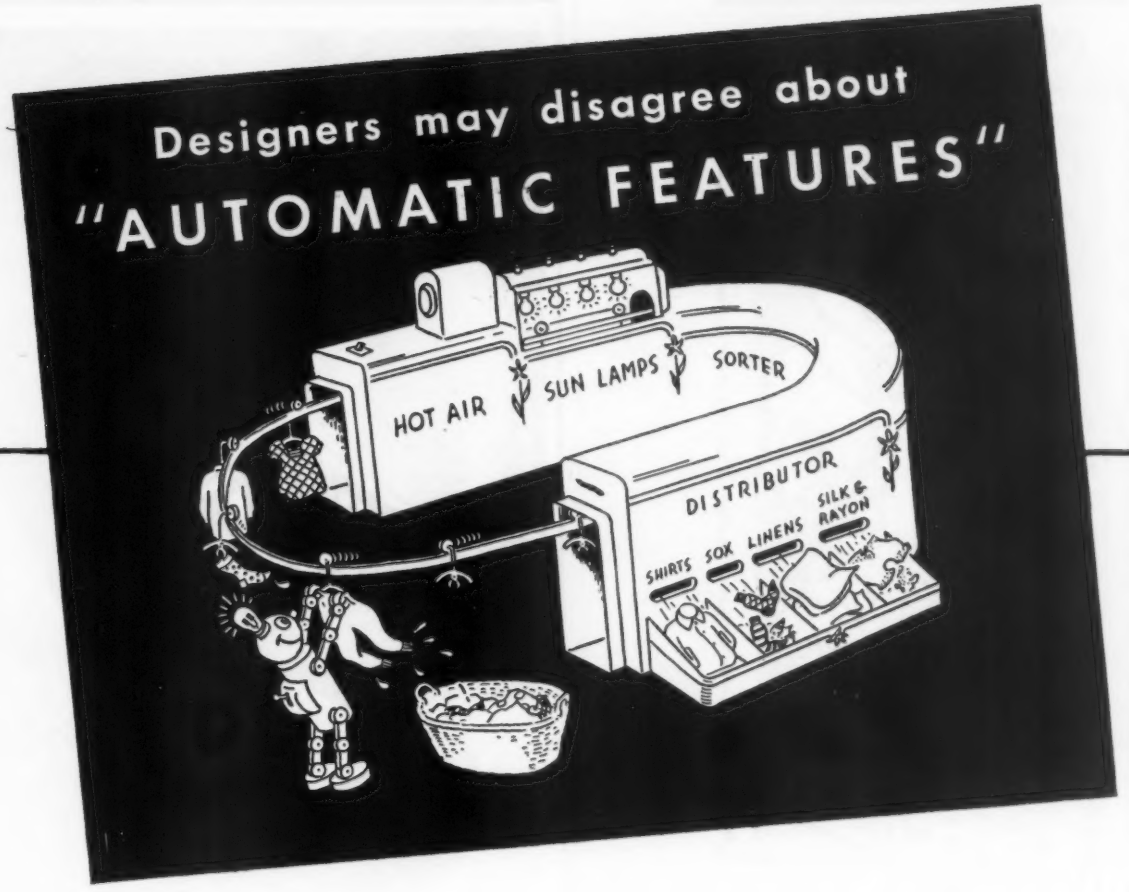
RAYMOND SPRINGS

WIRE FORMS — SMALL STAMPINGS

RAYMOND MANUFACTURING CO.

DIVISION OF ASSOCIATED SPRING CORPORATION

CORRY, PENN.



...but they all know a CLOTHES DRIER MUST HAVE GOOD INSULATION

Among the new products being developed for Postwar Homes, one of the most interesting is the *Clothes Drier* (which we are confident will *not* look anything like the picture above).

Smart looking and compact, the new Clothes Driers will fit perfectly into the laundry, kitchen or utility room. They'll do an excellent job. They'll save time and effort. And they'll be well insulated, undoubtedly, so the heat used in drying can be kept inside the cabinet where it belongs.

Good insulation will pay dividends, not only in keeping the heat from getting out into the room, but in making possible lower operating costs, always a big point with homemakers.

And if this insulation is Fiberglas*, you can be sure it will render long, dependable and trouble-free service. Being *inorganic*, Fiberglas is immune to rot and decay. Equally important, it is highly moisture resistant—picking up less than 1% by weight under extreme humidity conditions — and dries out without harm. It won't corrode—nor is it corrosive to aluminum or steel in the presence of moisture. Best of all, it won't settle or disintegrate—but "stays put" for life even when subjected to severe vibration.

In your manufacturing, too, you'll find Fiberglas offers decided advantages. Its flexibility and easy handling qualities are a real boon to production. And its light weight can effect substantial freight savings. But get *all* the facts about Fiberglas!

Write *Owens-Corning Fiberglas Corporation, 1850 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*

ARMY E NAVY

FIBERGLAS THERMAL INSULATION

*T. M. Reg. U. S. Pat. Off.

PORTRAIT OF AN

who says that even the newcomers can mate units more quickly when they assemble

SCREW MACHINE PRODUCTS

made FASTER and BETTER for LESS

by

U•S•AUTOMATIC

CORPORATION

Screw Machine Products

AMHERST • OHIO

Chicago Detroit New York

This Seal of Merit Symbolizes the Solution to your Sealing Problems

Seal rings developed by Pure Carbon are meeting the most exacting demands for efficiency. In applications where low friction, non-abrasive and long-lasting seal rings are a necessity, our carbon seal rings are demonstrating their superiority to the complete satisfaction of increasingly more manufacturers. Consult the Pure Carbon engineer in or near your city. He'll gladly co-operate with you in working out the answer to your sealing needs.

SEND FOR NEW BOOK DEFINING USES OF CARBON SEAL RINGS

PURE

Pure Carbon Co., Inc.

2102 Nobrac Street

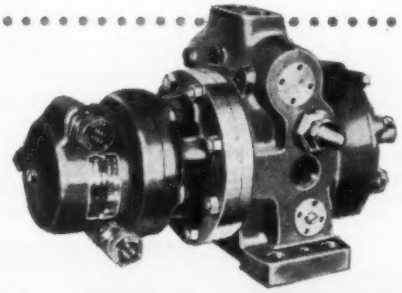
St. Marys, Pennsylvania

HYDRAULIC *Design*

EQUIPMENT AND ENGINEERING SERVICE AVAILABLE FROM SUNDSTRAND

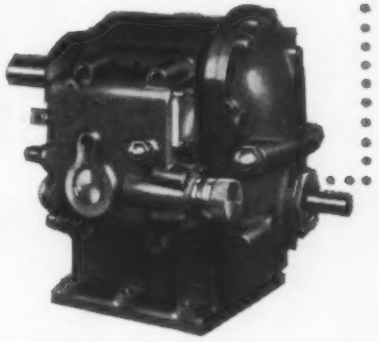
Here's modern equipment for modern hydraulic circuits. With it you can easily get a wide range of infinitely variable speeds and feeds to suit design and performance requirements of modern materials in *both* cutting tools and work. Either standard elements for your own circuit designs or complete circuits built into self-contained units are available.

PUMPS

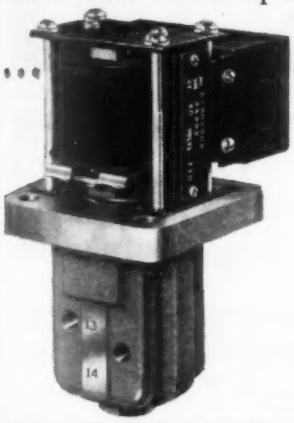


Standard constant displacement pumps, without relief or control valves are available in capacities from 2 to 15 G.P.M. With relief valve and directional control valve they are available in capacities from 4 to 18 G.P.M. . . . Our PWX pump (illustrated) is a combination variable displacement, piston and constant displacement type pump. Both feed and traverse rates are obtainable from this pump.

HYDRAULIC TRANSMISSIONS



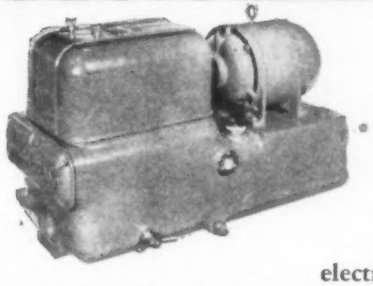
Providing a variable speed left or right hand rotation with neutral are available. Output speeds from 0 to 2500 r.p.m. are obtainable. Write for free descriptive bulletin.



VALVES

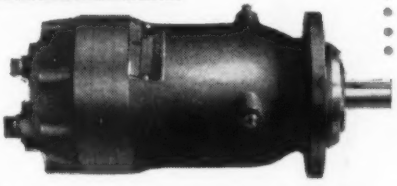
Relief valves, pilot valves, directional control valves, solenoid valves, pressure-reducing valves and cycle valves are all obtainable. Shown, is a single solenoid operated valve.

COMPLETE SELF-CONTAINED HYDRAULIC UNITS



These complete units contain pumps, control valves, electric drive motor and oil reservoir. They are compact units which can be placed in convenient positions. Designed to suit your equipment, they save considerable design and assembly time.

FLUID MOTORS



Both constant and variable displacement type motors are available. The simplicity of design and application of these motors makes it possible to apply this type of power transmission wherever a wide speed range with smooth speed is required. Write for free descriptive bulletin.

HOW TO USE THIS EQUIPMENT AND SERVICE TO ADVANTAGE

✓ Design engineers will find dependable, easily applied hydraulic elements in the pumps, valves, etc. described above. For those not having hydraulic design facilities, our engineers will be glad to help in designing circuits and units to meet your requirements. Call on them without obligation.

SUNDSTRAND MACHINE TOOL CO. · ROCKFORD, ILLINOIS, U.S.A. ·

SUNDSTRAND PUMP DIVISION

2556 ELEVENTH ST., ROCKFORD, ILLINOIS

FUEL UNITS, HYDRAULIC PUMPS, TRANSMISSIONS, FLUID MOTORS, VALVES, *and* CONTROLS

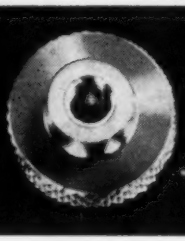
OUT OUR WAY BY J. R. WILLIAMS
SAY, ALECK, THAT'S A REPAIR JOB TO GET ONE OF OUR OWN MACHINES GOING AGAIN. JUST SHAVE OFF THEM CENTER HOLES WHEN YOU GET IT DONE.
O.K. BUT YOU SURE NOW IT'S LONG ENOUGH FOR THAT?
YOU CAN'T STOP THE OLD BULL— HE'S GOT TROUBLE ENOUGH MANNING THE MACHINES HE'S GOT AND NOW HE GOES AROUND GETTING MORE OF THEM MOVING.
MAYBE HE FIGURES HE'S GOING TO RUN IT HIMSELF IN HIS SPARE TIME WHICH HE HASN'T GOT, OR MAYBE ONE OF THE GIRLS IN THE TYPIST DEPARTMENT WROTE HIM A LETTER FOR A JOB.
THE DEAD END
J.R.WILLIAMS

The 'Old Bull' Keeps 'em Rolling

He's not waiting around hoping someone else will hurry up when he's slowed up. The 'Old Bull' and his kind all over the country just keep on burning up the trail that's making things hot for Hirohitler. And they're not letting up a minute on delivering our fighting men the very best—giving to our war-machine the top precision that will outclass and outfight the enemy at every point. And it's precision production learned under the pressures of war that's going to make finer, better products available on a mass scale when the war is over.

(*Below*) A few of the many thousands of our precision parts that help "Keep 'em flying and fighting." Let's all back the attack—buy EXTRA War Bonds.

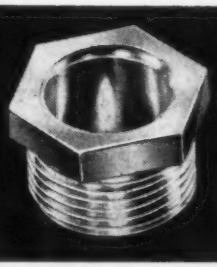
ERICSSON ESTABLISHED 1911



ERICSSON

SCREW MACHINE PRODUCTS CO., INC.

25 LAFAYETTE STREET, BROOKLYN 1, N. Y.



An Exceptional Opportunity for Research Scientists

One of America's largest organizations engaged in conducting research for industrial corporations and governmental agencies is expanding its present staff of 300 people.

Research-minded engineers and scientists, who can measure up to this organization's high standard, are invited to investigate the wartime and postwar opportunities of the Armour Research Foundation.

Important work of challenging interest is open to scientists in the following fields:

Physics	*Automotive Engineering*
Chemistry	*Chemical Engineering*
Metallurgy	*Electrical Engineering*
Ceramics	*Mechanical Engineering*
Electronics	*Civil Engineering*

Men and women who can be released from present duties and meet the above qualifications are assured salary and opportunity commensurate with ability. And, future research commitments promise postwar permanence. If you are interested, please write immediately.

{ Applications are also invited from scientists who are on leave of absence from educational institutions for the duration. }

ARMOUR RESEARCH FOUNDATION
West 33rd Street, Chicago 16, Illinois

a new DEEP-IMMERSION GUSHER COOLANT PUMP BY RUTHMAN

IN TWO LENGTHS

19 inches and 23 inches below the high level line of coolant reservoir. Model HL-15025-B has been produced to meet the need of machine tool requirements for greater tank capacity and utility of floor space.

Furnished with ¼ HP motor for continuous duty and ½ HP motor for extra heavy duty, in standard current characteristics. Entire rotating assembly on heavy one-piece ground shaft is *electronically* balanced. Simple installation.

Types and models available for every requirement.

WRITE FOR CATALOGUE

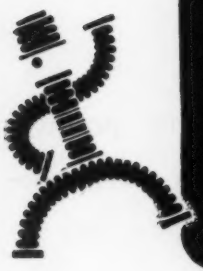
THE RUTHMAN MACHINERY COMPANY
1813 READING ROAD CINCINNATI 2, OHIO
The "Gusher"—A Modern Pump for Modern Machine Tools

The Proof is in the Parts

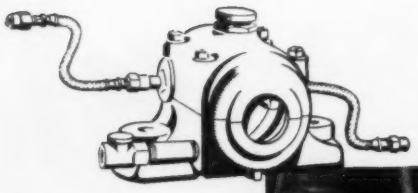
Whitney Roller Chains are built to give positive, powerful performance in the constant service demanded by wartime schedules. Every part may be relied upon to do its part.

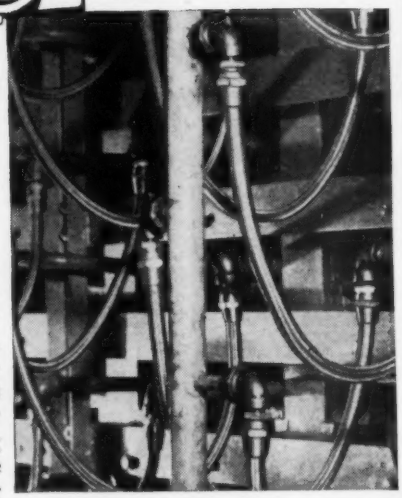
WHITNEY
120
Plates, punched from alloy stock, are heat-treated for maximum strength and toughness.
Pins have high shear value and resistance to wear. They are case hardened and centerless ground.
Bushings are die drawn from selected alloy steels, properly case hardened; held to close limits, smoothly finished.
Rolls, die drawn or turned from solid alloy bars; heat-treated for toughness.

THE WHITNEY CHAIN & MFG. CO.
HARTFORD, CONNECTICUT



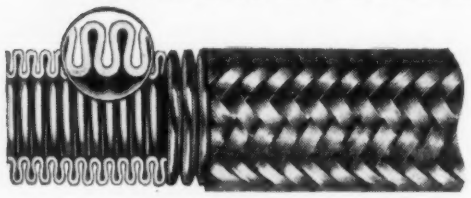
From PILLOW BLOCK to PLATEN PRESSES . . . REX-WELD GIVES YOU BETTER FLEXIBLE CONNECTIONS!





Versatility is an outstanding characteristic of REX-WELD, and progressive engineers are putting this fact to work every day, by specifying REX-WELD Flexible Metal Hose wherever top-quality connections are required. From water cooling lines on precision pillow blocks . . . to "looping the loop" on big platen presses . . . this C.M.H. product is solving problems with high efficiency in practically every industrial field. Check the features below, and see if you don't think REX-WELD can provide *better* connections on *your* particular job. Our engineering department will be glad to give you complete information.

- Withstands high pressures and temperatures.
- Seep-proof to gases and liquids. Rust-resistant and non-deteriorating.
- Extreme flexibility, uniform wall thickness.
- Non-collapsible and non-kinking.
- Long mill lengths.
- Rex-Tite Couplings, heat-proof, with metal-to-metal seat, impervious to temperature changes and leakage.



Rex-Weld Hose, braided, annular and helical corrugations.

ARMY E NAVY Flexible Metal Hose for Every Industrial Use

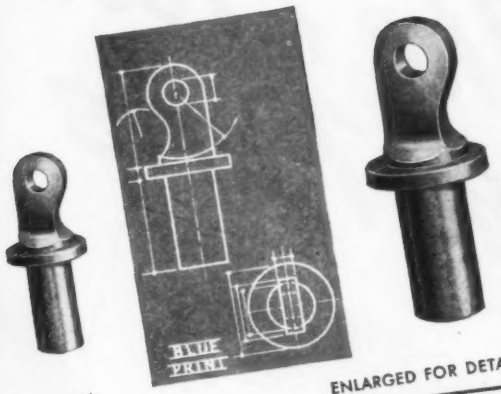
CMH

CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

ANOTHER SPECIAL BY PROGRESSIVE

QUALITY PROMCO BRAND



ACTUAL SIZE

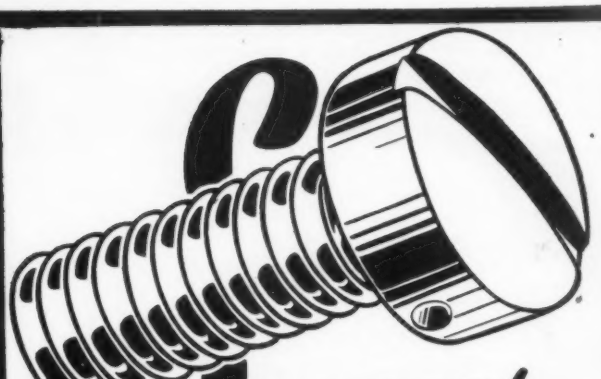
ENLARGED FOR DETAIL

71 other "specials" are illustrated in Catalog 18, which includes tables of weights per 1M standard pieces, dec. equivs. of fractions, etc. Write for it.

Special heads, threads, and finishes — on fastenings of any metal or alloy adapted to cold-upset — are Progressive's specialty. Weekly output: 25,000,000.

The **PROGRESSIVE MFG. CO.**
48 Norwood St., Torrington, Connecticut

★ BONDS BUY MORE WAR BONDS ★



Screws

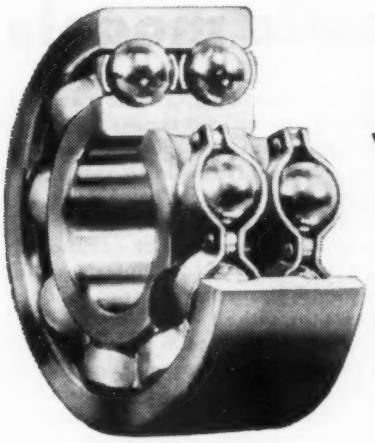
Special kinds—difficult kinds—tight specifications—close precision—special heads or threads.

If it is a Screw—we have, can or will make it.

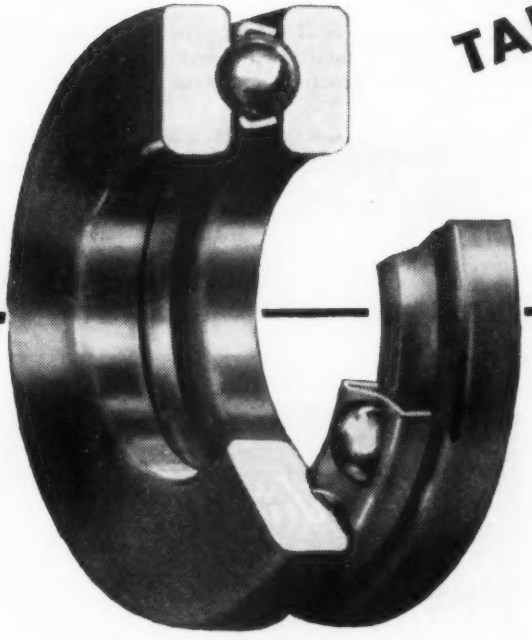
Write for easy reference, factual catalog.

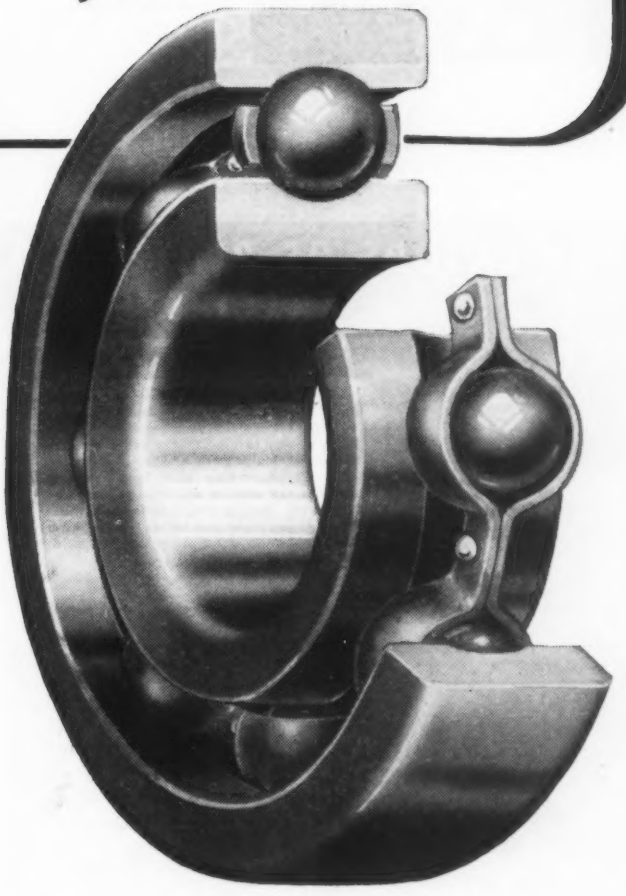
NEW ENGLAND SCREW CO.
KEENE, NEW HAMPSHIRE

MACHINE SCREWS — PLASTIC INSETS
SHEET METAL SCREWS — HOLDING PINS
MACHINE SCREW NUTS — SPECIAL RIVETS
ALL TYPES OF HEADS AND THREADS



THE EQUIPMENT *Never* TAKES THE BEARINGS FOR GRANTED





BEARINGS are familiar equipment parts, but designers cannot safely take them for granted. Because the equipment never does!

If bearings have been carelessly selected, the machine refuses to function efficiently... breaks down. That's why bearings must be carefully considered *at the time the equipment is designed.*

Use *ball* bearings wherever they are practical. Before writing specifications, carefully study the factors of friction, speed and loads.

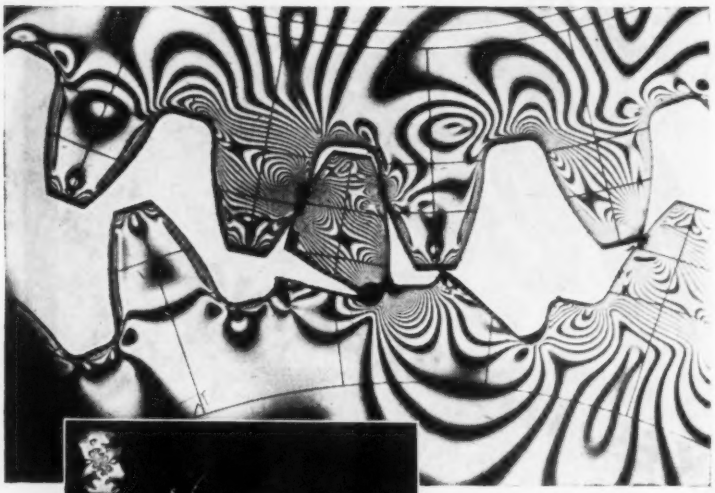
You're sure of careful, rugged construction and long life when you choose BCA Ball Bearings. BCA engineers will gladly help you select the right bearings for any standard or new equipment you may be planning.

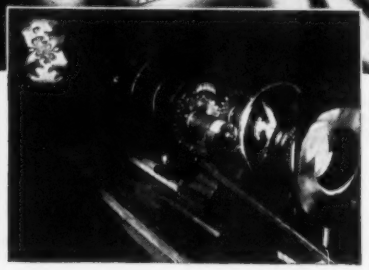
BEARINGS COMPANY OF AMERICA
LANCASTER, PENNSYLVANIA

BCA

RADIAL • ANGULAR CONTACT • THRUST
BALL BEARINGS

GEAR TESTS made with plastic models





MADE TO ORDER
Hypoid, Helical, Herringbone, Spur, Spiral Bevel, Straight Bevel, Worm and Zerol Gears; also, complete Differentials and various Splined Shafts.

Actual observation of *why* and *how* a gear tooth fails under excessive load is possible with Photoelastic equipment and plastic gear models now being used by Fairfield in research work on the strength of gears.

This is a visual check on the findings made by use of formulae, and a distinct advance in the science of gear making. A polarized light is passed through transparent gear models and the image on the screen shows in color the lines of stress which develop; permanent records are made by substituting a camera for the screen.

Gears are a primary factor in machinery, and Fairfield, backed by 25 years of experience, plus scientific research and modern inspection methods, can be relied upon to build into gears that superior quality essential for satisfactory use.

In anticipation of future production, investigate Fairfield facilities for making fine gears—write for our brochure on gears.

FAIRFIELD MANUFACTURING CO.
313 S. Earl Avenue, Lafayette, Ind.

ARMY E NAVY
FAIRFIELD for FINE GEARS

FABRICATORS OF PLATE AND SHEET STEEL

Many manufacturers solve their Engineering and Purchasing problems—the Littleford way—by turning to our experience for certain fabricated parts or special products.

For 62 years they have been forming, bending, and welding all types of plate and sheet steel, making products for all industries. If you have a problem that requires fabricated parts, send blueprints or specifications to Littleford.

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LITTLEFORD BROS., INC.
506 E. Pearl St., Cincinnati, 2, Ohio

In these Vital Spots -

MINIATURE PIVOT BEARINGS

Two tiny pivot ball bearings — only 5mm. in diameter at the ends of the rotor shaft — reduce friction to the minimum and help obtain maximum possible torque from this AMGLO Constant Speed DC Motor, now giving reliable, trouble-free service in many vital military and civilian applications.

You, too, can use MINIATURE Pivot or Radial Ball Bearings. Send for Bulletin PE-1-44.

Outside diameters: pivot bearings 2mm. to 10mm; radial bearings 1 8" to 5 16".

Minimize with Miniature

MINIATURE *Precision* BEARINGS
KEENE, NEW HAMPSHIRE, U.S.A.

ONE GOOD TURN CONSERVES ANOTHER

TWIN-FAST SCREWS require only half as many turns of the driver—half the driving time —half the driving cost!

Twin-Fast's exclusive feature (parallel twin threads) provides twice the thread pitch of the conventional wood screw. With one complete turn of the driver, the Twin-Fast Screw goes twice as far into the wood! ● Twin-Fast is standard as to number of threads per inch, but a Twin-Fast Screw with 26 threads, for example, requires only 13 turns to drive it in! ● Speeds production, saves man hours! And saves wear and tear on the threads formed in the wood—that means greater holding power! ● Assure yourself of Twin-Fast's many advantages—right in your own plant. Write for samples today.

Other Twin-Fast Features

Relieved shank diameter prevents stresses which might cause immediate or eventual splitting or fissures.

Single, sharp, centered point where twin threads terminate assures quick starting, self-centering, balanced driving.

Cylindrical construction (not tapered) increases thread area for tighter seating, greater holding power. Often, fewer and shorter screws may be used.

Twin-Fast Screws come in steel or brass with round, flat or oval heads—standard sizes and thread count.

BY ALL MEANS—BUY BONDS!

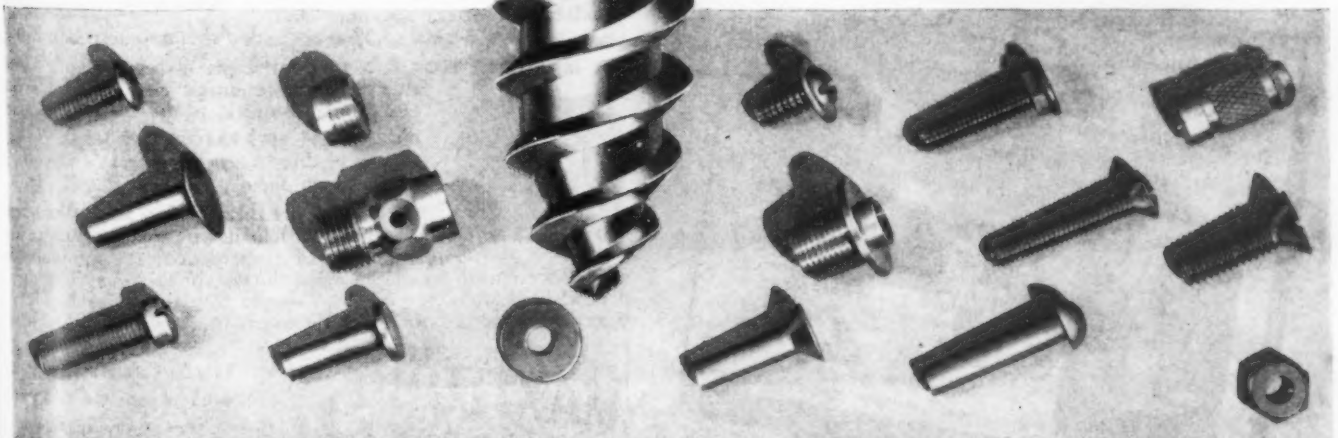
For Faster Production—Sounder Construction—

TWIN fast

Reg. U. S. Pat. Off.

TWIN THREAD WOOD SCREWS

Patents 2,314,390; 2,314,391. Other pats. pending.

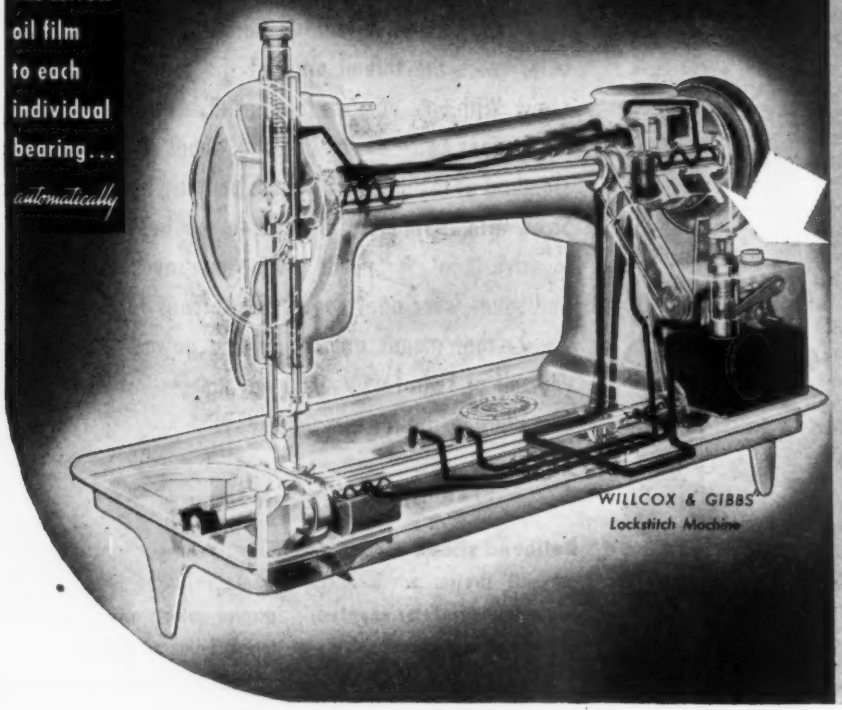


The Blake & Johnson Company makes many thousands of different types of fastening devices in all standard metals.

THE BLAKE & JOHNSON COMPANY *(Since 1849)* WATERVILLE, CONNECTICUT

METERED to close limits . . .

The correct oil film to each individual bearing . . . *automatically*



■ **HIGH-DUTY PERFORMANCE** . . . with standards more exacting . . . today is demanded of progressive machines, independent of size. To insure uninterrupted operation and savings in maintenance, reliance best can be placed on positive, "built-in," metered lubrication. **BIJUR** equipment—economical for machines of all types and sizes—provides automatic oil-feed down to a "fraction" of a drop!

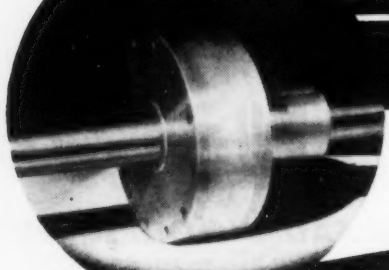
BIJUR LUBRICATING CORPORATION
LONG ISLAND CITY • NEW YORK

BIJUR

AUTOMATIC *Metered* LUBRICATION

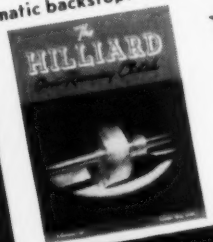
1727

THE **HILLIARD** *Over-Running Clutch*



A "Free Wheeling" Clutch of simple design recognized for many years as "Standard Equipment" for Automatic Dual Drive operation—Automatic operation of 2 Speed drive—As a ratchet permitting infinite adjustment and as an automatic backstop. Furnished in a number of types.

★ *WRITE TO-DAY!*



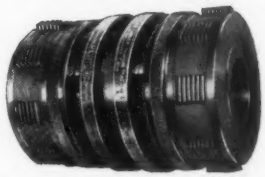
For the new series of 6 illustrated Bulletins furnished FREE upon request, featuring our complete line of Industrial Clutches and Couplings—showing typical applications and their use in modern industrial engineering facilities.

OVERLOAD RELEASE SLIP
CENTRIFUGAL FRICTION SINGLE REVOLUTION

★ **THE HILLIARD** *Corporation* ★
101 WEST 4TH ST. ELMIRA, N. Y.

Play Safe with **MAXITORQ**

NO DRAG · NO ABRASION · NO HEATING



That's what many important manufacturers . . . and users . . . of nationally known machines are doing today. They have recognized the safety and operational features of Maxitorq : . . the plus values that give to their power transmission installations better, smoother and more positive action . . . even under the toughest conditions.

THE MAXITORQ FLOATING DISC principle assures smooth clutch engagements, quietness, cool running without drag, and quick, positive disengagement.

MAXITORQ SEPARATOR SPRINGS prevent contact of discs when in neutral . . . "you can see between them".

NO TOOLS are needed for any adjustment, assembly or take-down of the clutch. The simplicity of construction, the compact design, the accurate finish . . . make the Maxitorq an easy handling, dependable clutch . . . one you should investigate for newly designed machines . . . or for replacement of obsolete transmissions.

MAXITORQ *floating* **DISC CLUTCH**

SINGLE AND DOUBLE WET AND DRY TYPES are available in capacities from ¼ to 5 H.P. at 100 R.P.M. Made also in Pulley and Cut-off Coupling types.

CATALOG NO. 4 READY

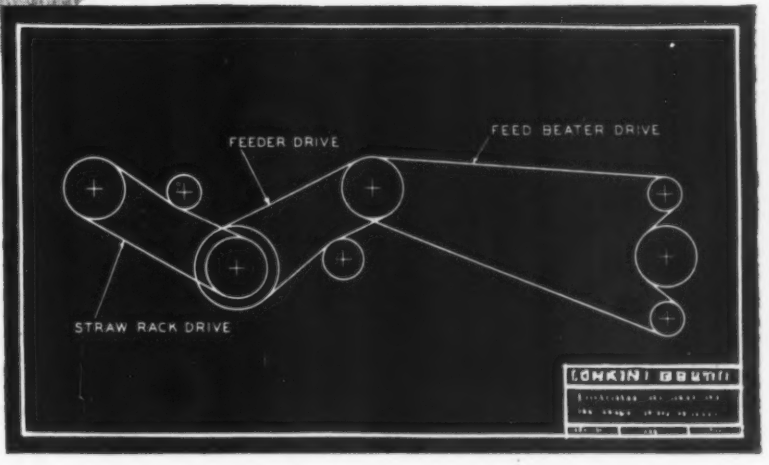
THE CARLYLE JOHNSON MACHINE COMPANY
• MANCHESTER, CONNECTICUT •

"THEY FOUND THE *Right Combination* FOR A COMBINE"

1 STRENGTH, ACCURACY—these are the two basic requirements for a combine-drive. Strength to stand up under heavy loads and resist the dust, heat, rain and mud of farm service . . . accuracy to properly time and co-ordinate the various intricate functions of the combine. Machine designers found the right combination for both in one drive . . . Baldwin-Rex Roller chain belts.

2 THERE'S NO SLIPPING, no wasted power . . . with Baldwin-Rex on the job. Every mechanical operation of the combine is accurately timed to mesh perfectly with each successive step. Shocks of traveling over rough ground are not passed on to the transmission or other machine parts for these chain belts are highly shock absorbent. Baldwin-Rex is a positive drive that's positively right for all types of power transmission, timing and conveying functions.

3 HERE'S WHERE THEY WORK. This drive design arrangement of the combine shows how Baldwin-Rex transmits power from the engine, drives the straw rack, the feeder, the feed beater, the shaker and fan. The smooth, quiet operation, simplicity of installation and adjustment, compactness and low maintenance of these chains make them the most efficient means of transmitting power and timing operations.



For catalogs on Baldwin-Rex Roller chain belts or competent information on your specific drive problems, write to **BALDWIN-DUCKWORTH** *Division of* **CHAIN BELT COMPANY,** *321 Plainfield Street, Springfield 2, Mass.*

BALDWIN-REX *ROLLER CHAIN BELTS*

Baldwin-Duckworth Division, Springfield 2, Massachusetts • Rex Chain Belt and Transmission Division, Rex Conveyor and Process Equipment Division, Milwaukee 4, Wisconsin

Courtesy of RIVETT LATHE & GRINDER INC., Boston, Mass.

RIVETT "UNIVERSAL" Milling Attachment for Rivett Bench Lathes

ALLEN

FLAT HEAD CAP SCREWS

This application on a RIVETT Lathe shows how to get the HOLDING-POWER of hex socket screws in such an essentially flush-surface part as a knee or a slide rest. The V-head of the Allen screw fits the counterbore with complete *closed contact* all round. This gives frictional grip and a locking rigidity, reinforced by the tightest of set-ups possible only by powerful wrenching with an Allen Hex Key.

The ALLEN Flat Head Cap Screw is "pressur-formd" of Allenoy steel, with uncut metal fibres shaped to the head. Threads also are *pressur-formd*, with tolerances held to a high Class 3 fit. Strength and precision distinguish these screws in all their applications.

Procurable from your local ALLEN *Distributor; ask him for samples and dimensional data.*

The Allen Mfg. Company ★ ALLEN ★ Hartford, Conn., U. S. A.

This Name Plate Stands At The TOP IN ITS FIELD

On a rotary pump, the Viking name plate is your guarantee of service and dependability.

Those who have had Vikings in operation know what this really means, particularly in War-time, when it has been so difficult to obtain new equipment. Many Vikings are still standing up and doing a swell rotary pumping job, even though in normal times they would have been replaced long before now with new equipment.

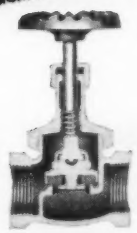
This ability to "take it" and to "keep going" is proof of the sound design and rugged construction of Viking Rotary Pumps . . . features that insure dependable performance . . . features that mean the difference between a shut-down and keeping on the job. When writing about a pump in service, always mention the serial number shown on the name plate.

Look to the future. Write today for Bulletin 300 which describes Viking Rotary Pumps widely used in the product engineering field. Viking pumps are available on priority. Inquire as to delivery date.

VIKING Pump COMPANY CEDAR FALLS IOWA

for reliable service on working steam pressures up to 125 lbs., you can't beat . . . .

HAMMOND dependable VALVES



• Volume production on one type of valve enables Hammond to offer industrial users a high grade precision built product of unmatched valves in the 125 lb. class. Globe valves, check valves for iron pipe or copper tubing in sizes from ¼" to 2" built to

. . . fit the job . . .

with decided economies on original equipment or for service installations.

Full waterway—Full opening—Extra pipe clearance — Broad faced seat—Encased disc—Packed under pressure — Jewel packing rings.

HAMMOND BRASS WORKS
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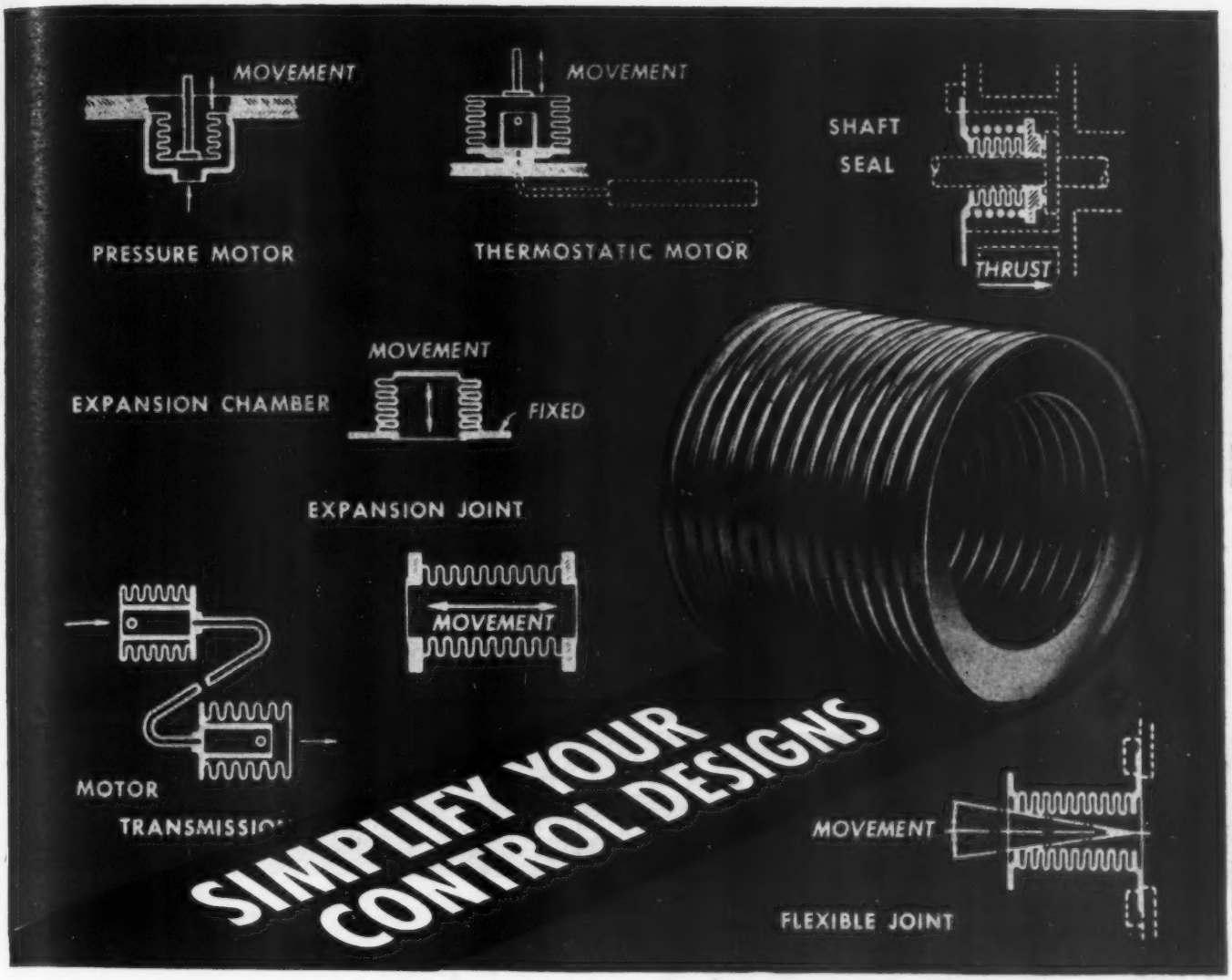
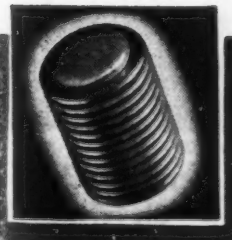


WHEREVER there are temperatures or pressures to be controlled—expansion to be absorbed—motion transmitted or rotating shafts to be sealed—correctly engineered bellows offer a *simple* solution to seemingly complicated problems of design.

They can be made strong enough to withstand high pressures—with multi-ply walls if necessary—or delicate enough for thermostats designed to convert minute temperature changes into calibrated mechanical movement. There is no end to the design possibilities of Bridgeport Bellows.

* * *

Whatever your problems involving bellows, we invite you to lay them before us. A complete service is at your disposal—engineering, experimentation, testing and manufacturing facilities geared to meet today's production requirements. Write for our new catalog. Ask for AP-100.



Bellows Assemblies . . . Bellows . . . Bellows Devices

BRIDGEPORT THERMOSTAT

COMPANY, INCORPORATED—BRIDGEPORT 1, CONN.

SURPRISINGLY *Economical* in SPACE REQUIRED and OPERATING COSTS

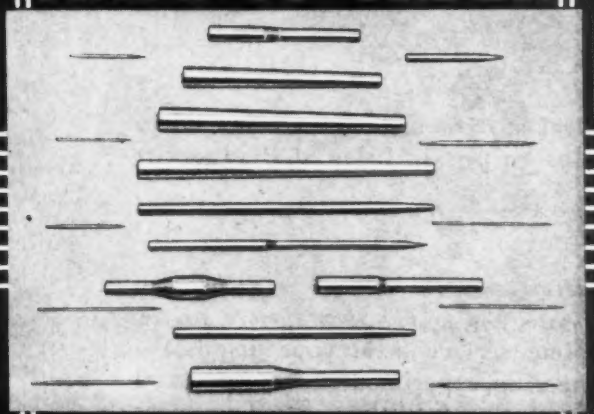
The WHS Differential Speed Reducer also offers the advantages of . . . Sustained High Efficiency . . . Smooth Action . . . Even Load Distribution . . . Quiet-running Helical Gears . . . and Freedom from Vibration.

Horizontal, vertical and flange-mounted types are fully described in our new Catalog No. 144.

WINFIELD H. SMITH, Inc.

111 EATON STREET, . . . SPRINGVILLE . . . ERIE COUNTY . . . NEW YORK

MADE TO ORDER



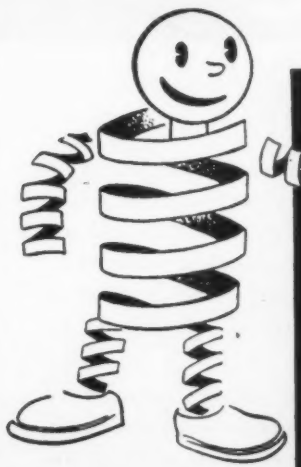
Tubes, Rods, Wire reduced by rotary swaging to your specifications by the pioneer rotary swaging machine builder.

Cuts show various tubes reduced, tapered and closed on end by swaging. Solid work up to 5/8" diameter and medium wall tubing up to 2 1/2" O. D. can be handled.

You benefit from our nearly seventy years' rotary swaging experience.

The Torrington Company
SPECIALTY DEP'T.
Torrington, Conn., U.S.A.

"COIL SPRING" Says



You can't beat U. S. STEEL WIRE SPRING deliveries if you have high priority rating. Nor can you beat the quality that comes from long experience — modern equipment — and capacity to handle urgent requirements on schedule. Direct your next order to U. S. Steel Wire Spring for speed and dependability.

EXTENSION
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FLATS
WIRE FORMS

STANDARD ROUND EDGE DIE SPRINGS

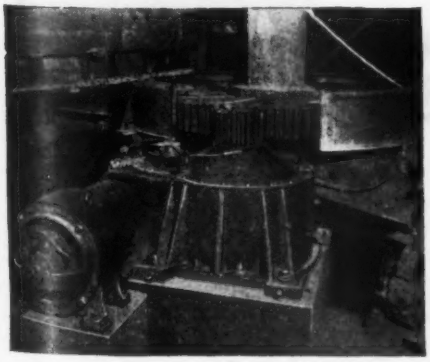
The U. S. Steel Wire Spring Co.

7800 Finney Ave. **Cleveland, Ohio**

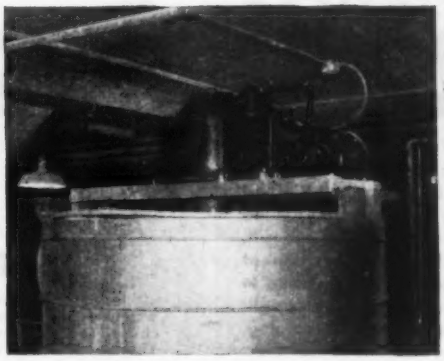
Jones WORM-HELICAL SPEED REDUCERS -for Vertical Shaft Drives

THESE machines fill a long felt need for double reduction units of the fully enclosed type to be used for agitators, mixers, ore roasters, bending rolls, etc., requiring a vertical shaft drive. Built in standard ratios in various types of assemblies ranging from 40 to 1 to 250 to 1 for all common motor speeds and a wide range of horsepower ratings.

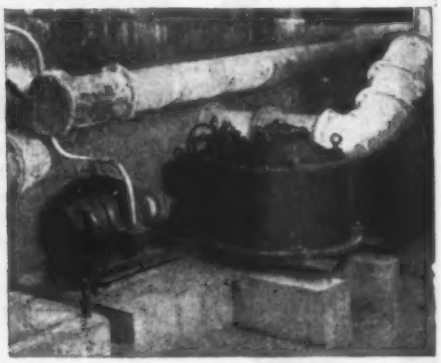
Jones Bulletin No. 75 covers complete details on these Worm-Helical Speed Reducers, with rating tables, dimension diagrams, torque charts and other application information. We shall be pleased to send you a copy.



• Jones Worm-Helical Speed Reducer on ore roaster with section of dust guard removed to show final gear reduction.



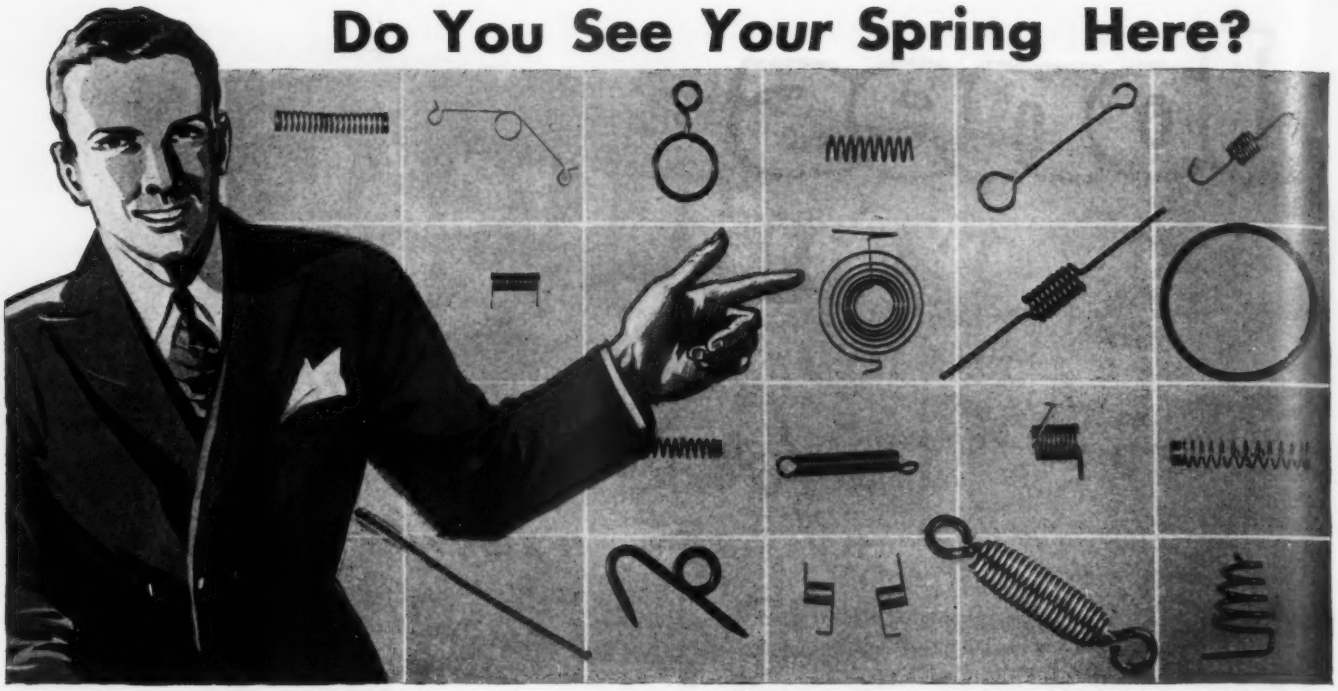
• Jones Worm-Helical Speed Reducer driving a lacquer agitator. A simple design prevents leakage of oil along the vertical low speed shaft.



• Jones Worm-Helical Speed Reducer on a paper mill agitator drive.

W. A. JONES FOUNDRY & MACHINE CO., 4417 Roosevelt Road, Chicago 24, Illinois

Do You See *Your* Spring Here?



We specialize in fitting the spring to the need! If the spring for your postwar product is not pictured above, describe how and where it will be used and our engineers will suggest the right design for the job. This holds good also for your present products. The performance of many an existing appliance or machine could be materially improved merely by supplanting old springs with new ones "engineered" into the design. Peck Springs are made up to ⅛" wire size. Let's get together.

THE PECK SPRING CO., WELLS ST., PLAINVILLE, CONN.

Peck SPRINGS & SCREW MACHINE PRODUCTS

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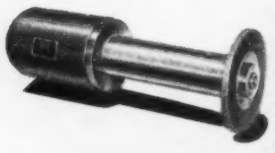
HOSE CLAMPS
For All Applications

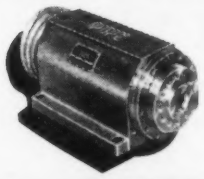
The dependability of Wittek Hose Clamps, long accepted by the automotive and aviation industries, is now being proven by actual service with the armed forces of the United Nations as standard equipment for aircraft, tanks, jeeps, trucks, ships and other combat vehicles. Wittek Hose Clamps are made in many different sizes and types for all applications. Write for new descriptive catalog. Wittek Manufacturing Co., 4305-15 West 24th Place, Chicago 23, Illinois

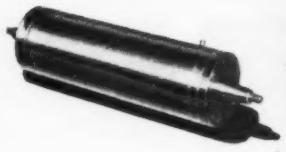
WITTEK WMCo. *Hose Clamps* Dependable Hose Connections



This POPE Sealed Motorized Spindle is ideal for all makes of 6" x 18" Surface Grinders. Equipped with *Sealed in* G-E motor and SKF Super-Precision Double Row roller bearings with sealed lubrication. Finer finishes and lasting dependability are assured.

This POPE Spindle is of the cartridge type, flange mounted in a heavy housing. It is used as a headstock on special purpose, high production lathes.





This POPE Tool and Cutter Grinder Spindle is a complete, self-contained package — sealed lubrication, cool running, long lived, requiring no attention.

A POPE PRECISION SPINDLE FOR EVERY PURPOSE

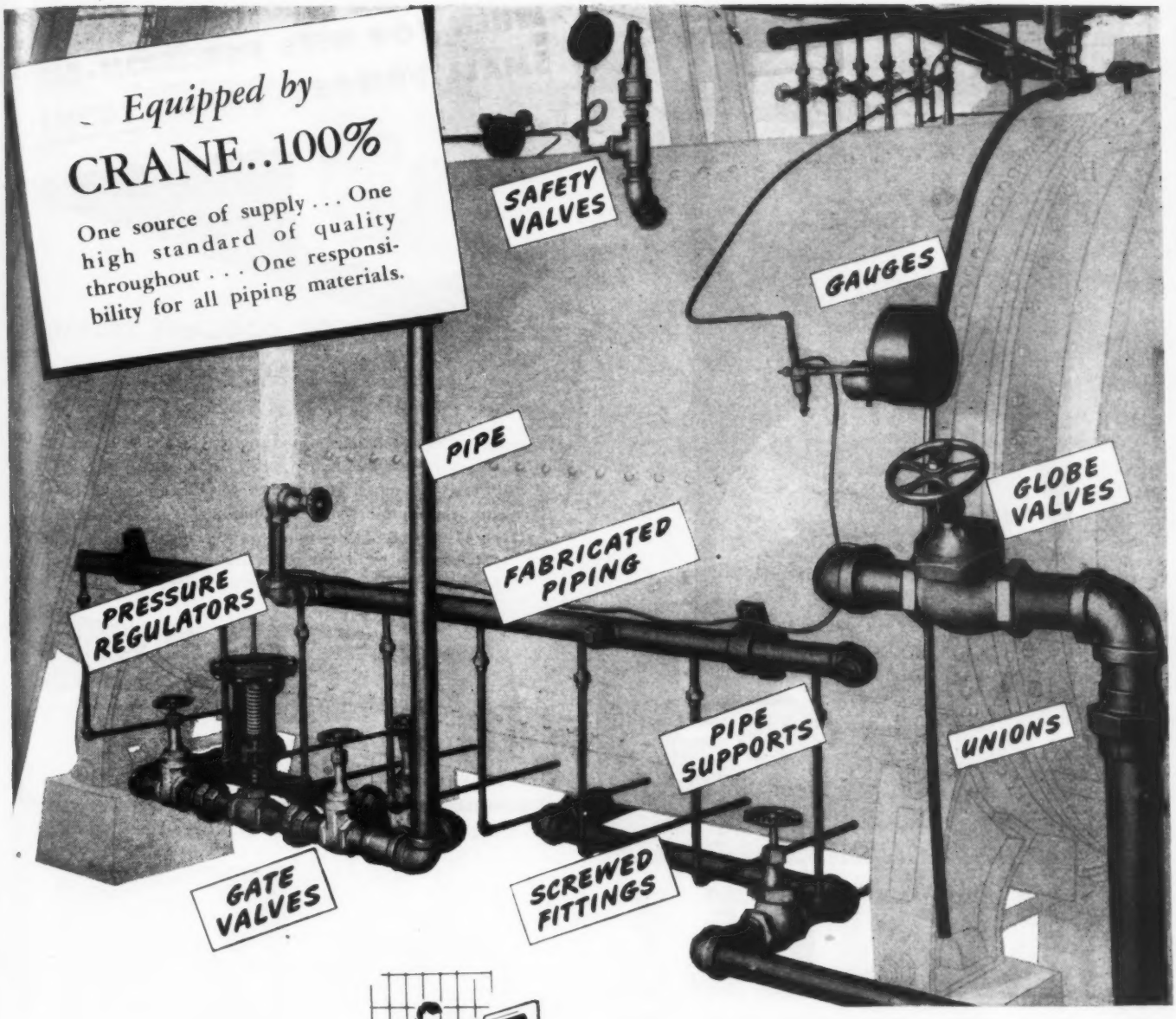
Send us a sketch or brief description of the spindle you want, with dimensions, and give us a rough idea of the machine, the method of holding wheel or tool, the speed, etc. Then we'll send you a Data Sheet that makes it easy for you to fill in the details. Once we have that, we can give you dependable recommendations with prices and delivery dates.

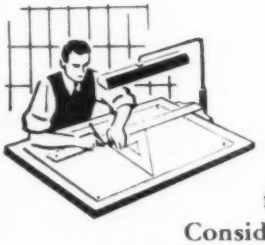
POPE MACHINERY CORPORATION
ESTABLISHED IN 1920
HAVERHILL, MASSACHUSETTS
BUILDERS OF PRECISION SPINDLES

Equipped by

CRANE..100%

One source of supply . . . One high standard of quality throughout . . . One responsibility for all piping materials.





IS THE PIPING HERE A DETAIL?

CAN you see the piping as a detail when the operation of a machine depends entirely on efficient flow-control?

Consider then, the important advantages of selecting from the world's largest line of valves, fittings, and everything that goes into piping. It assures your getting exactly what you need, be it for a simple lubricating line or an intricate processing system.

Consider the savings of time all down the line—from drafting room to product assembly—when equipment comes from one complete source.

Getting quality that's backed by Crane Co.'s 90-year leadership in the piping field is another advantage. The designer knows he can depend on it, and so does the equipment buyer.

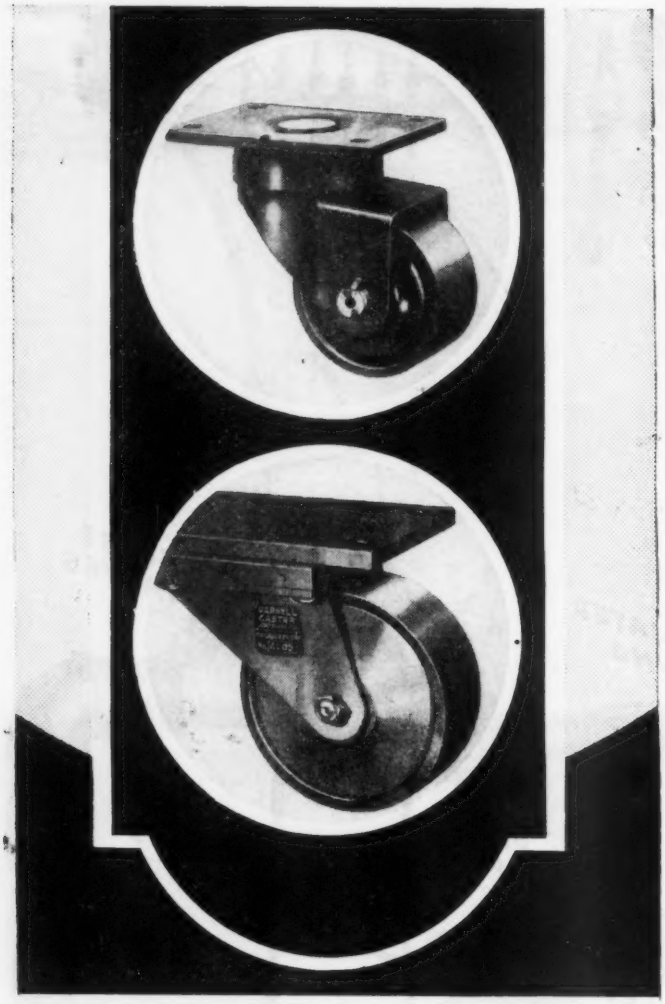
If you have a particular piping problem on products now in the making, or for the future, chances are the answer is in your Crane Catalog. If not, Crane will be glad to help you find it.

CRANE CO., General Offices: 836 South Michigan Avenue, Chicago 5, Ill.

90 YEARS OF PROGRESS 1855 1945

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS



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Built-in quality assures a long life of efficient service—it pays to "Demand Darnell Dependability".

Free DARNELL MANUAL

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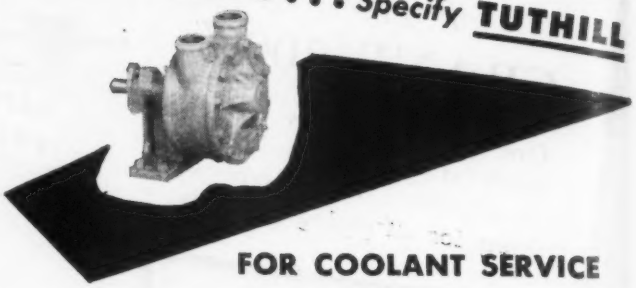
WHEN YOU NEED PRECISION-BUILT SMALL PUMPS . . . Specify TUTHILL



FOR COOLANT SERVICE IT'S MODEL M

Here's an internal-gear rotary pump with a built-in automatic by-pass that allows small chips and grit to pass through without serious injury to working parts. Precision-built, this Tuthill Model M pump provides long, uninterrupted service. Sizes from 1 to 50 g.p.m. Available in stripped form for direct incorporation into the design of the machine. Write for complete catalog.

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Tuthill Pumps are serving Army • Navy Air Force • Merchant Marine and Industry

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939 East 95th Street • Chicago 19, Illinois

***the* EQUITABLE POLICY**

Since the war began we have devoted ourselves largely to the production of bearings to special dimensions and we expect that because of our wide experience in their construction, these bearings will continue to be a large part of our output. However, we are now devoting an increasing amount of our facilities to the production of *many standard bearings* and we have just published our new 28 page bearing catalog showing in detail the complete line of Equitable Standard bearings. We continue to offer to work with your engineers in the design, application and service of any type of anti-friction bearing on which you may ask specialized advice. Look to Equitable for bearing information for any type application, standard or special.

Write for our new catalog No. 44

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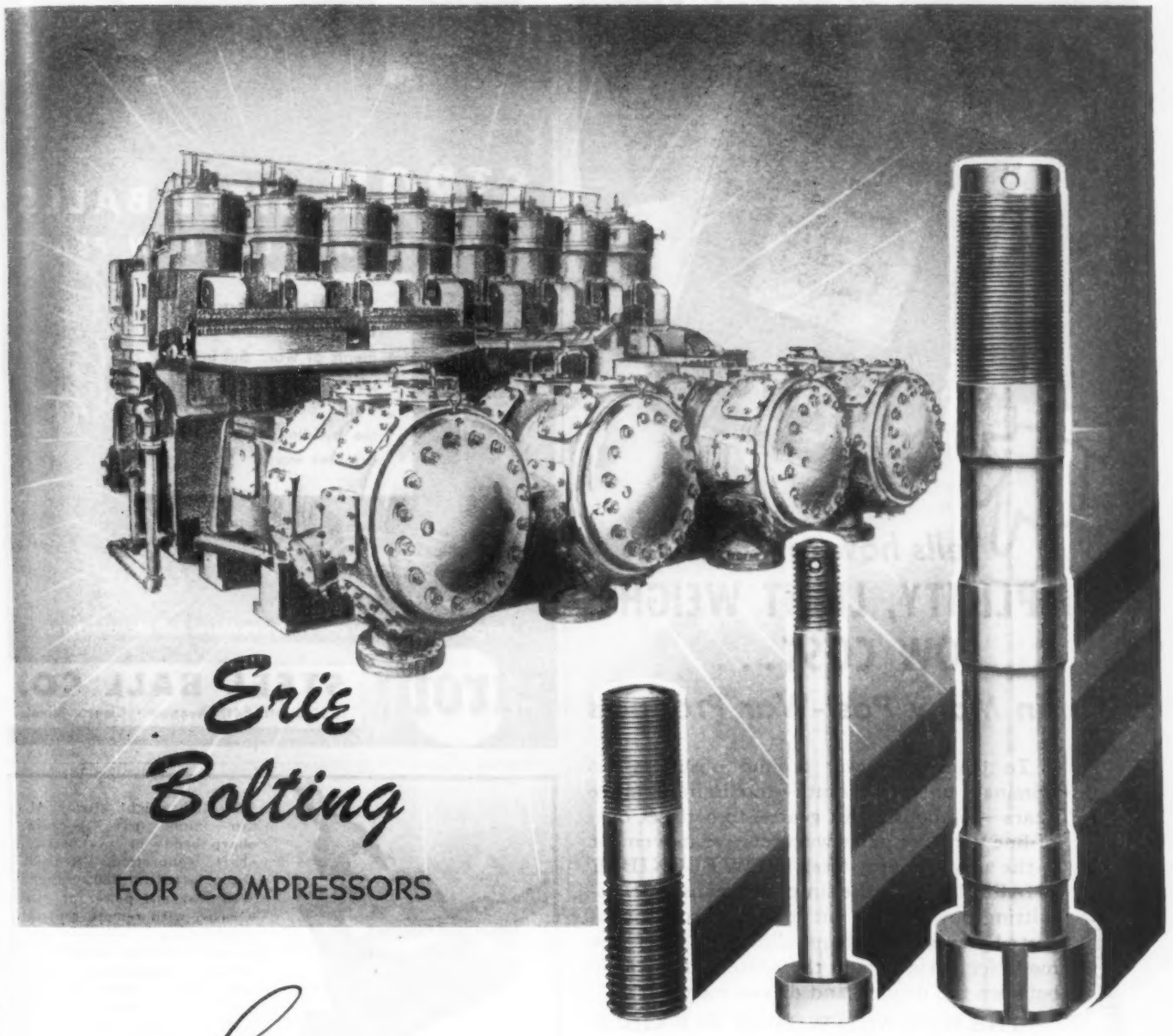

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ERIE is manufacturing bolts and studs to the exacting specifications of many compressor builders. We are equipped to work with any material heat treated and threaded to specification and machined to specified tolerances. Consult with Erie Bolt & Nut Company for your next requirements.

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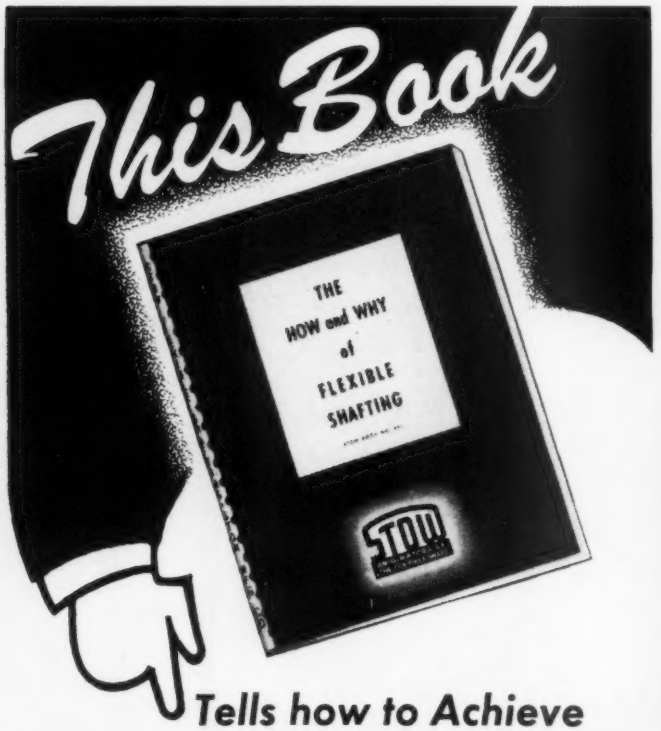

Tells how to Achieve

SIMPLICITY, LIGHT WEIGHT, LOW COST...

in Many Post-War Products

To transmit power around obstacles—to eliminate universal joints—to eliminate mitre gears—to abolish spur gears—to connect out-of-line parts, or parts with relative movement—the answer is very often STOW FLEXIBLE SHAFTING. It's the simplest means of transmitting power in or out of line, through congested areas, or where allowance must be made for variations in the route and distance between the driving and driven members.

"THE HOW AND WHY OF FLEXIBLE SHAFTING" is a fact-filled, diagram-packed book prepared especially for product engineers who realize that the competition of the post-war market must be met first by the designer. If FLEXIBLE SHAFTING can solve any of *your* problems, you'll find the basis for its use in the detailed technical data which fills this booklet.

● Hundreds of designers are now writing us for more complete information on FLEXIBLE SHAFTING. Many manufacturers ask us to make suggestions for incorporating this mechanical element in their post-war products. The FACTS in this Booklet will enable you to determine whether FLEXIBLE SHAFTING can solve design problems for you. ASK FOR YOUR FREE COPY TODAY!

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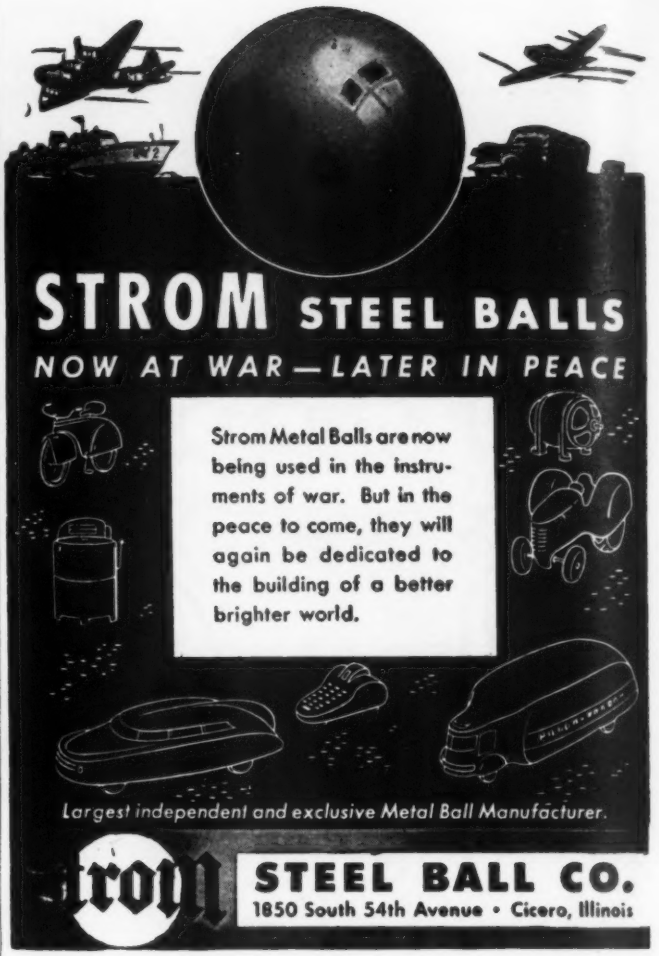
426 State St., Binghamton, N. Y.


STROM STEEL BALLS
NOW AT WAR—LATER IN PEACE
Strom Metal Balls are now being used in the instruments of war. But in the peace to come, they will again be dedicated to the building of a better brighter world.
Largest independent and exclusive Metal Ball Manufacturer.
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STEEL BALL CO.
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This lightweight sturdy Altair angle drive permits sharp bends in any flexible shaft connection. Swivels through entire 360° range. Will transmit power or can be used with remote control applications. Serviced by merely removing central bolt without disturbing shaft connections. Write Department 7 for complete information. Please indicate application desired.

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Bendix Aviation Corporation
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INCLUDE GUARDIANS

IN YOUR Post-War Planning

● Guardians have ably served in war and peace. When victory is won and your production is resumed, Guardians will be ready to serve you again.
Guardian Direct Drive Couplings have exclusive rubberized cushions. No parts to get out of order, or to lubricate.

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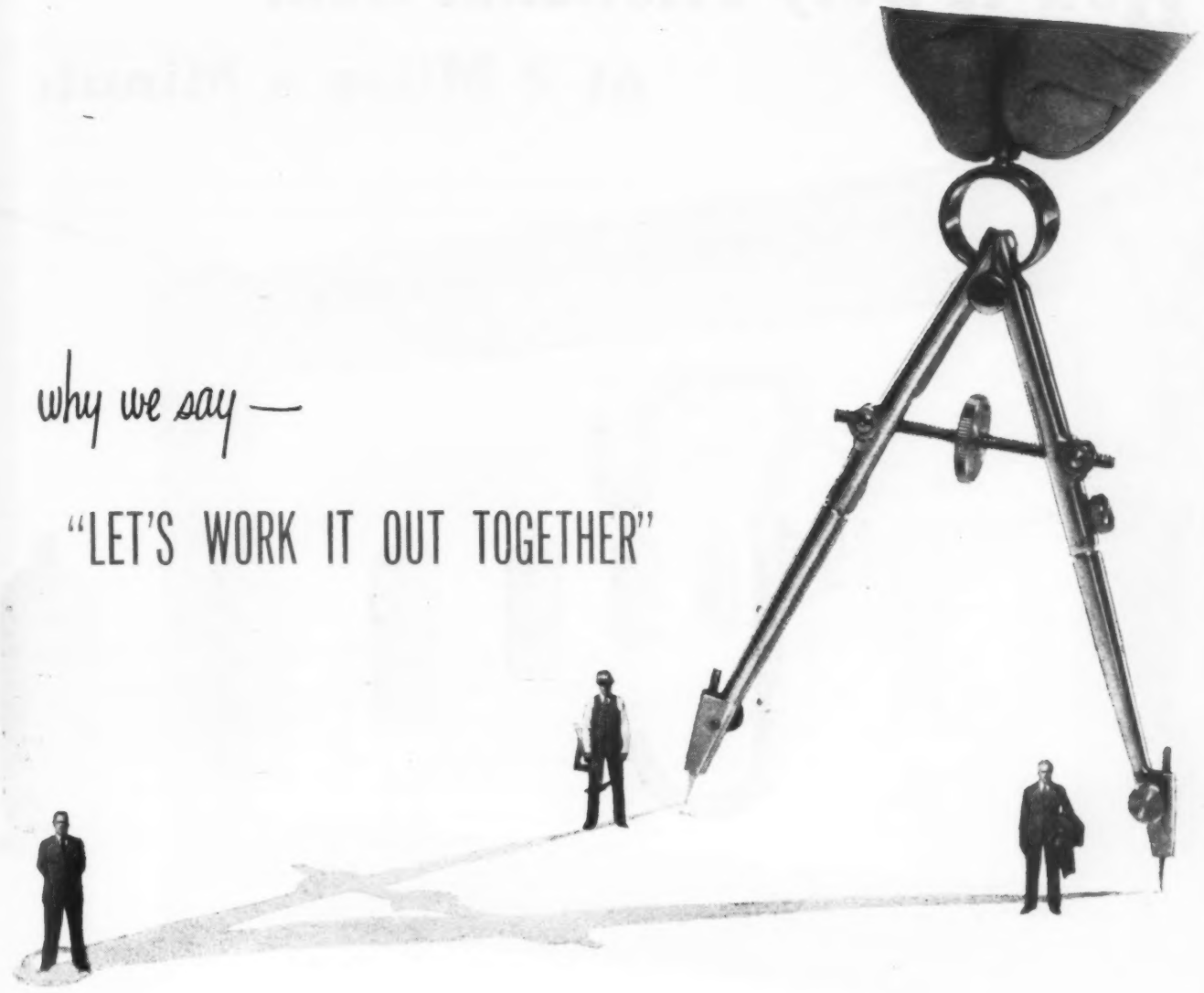

why we say —

"LET'S WORK IT OUT TOGETHER"

At Dow, we firmly believe there is one *sure* answer to success in plastics. It's a simple, friendly idea—yet so important that we are setting aside this advertising space to tell you about it.

Our work with many manufacturers and molders all over the country has proved the value of close and continuing cooperation with them in developing nearly every job. As plastics move into a period of even greater usefulness, this teamwork becomes increasingly important; for putting plastics to work *right* is not a one-man job. It is not even a one-industry job. Instead, it calls for the combined skill and experience of manufacturer and designer—working step by step with molder—and Dow.

That's why we say "*Let's work it out together*"—it saves time and money and puts plastics in their right place.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle

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STYRON (Dow Polystyrene) . . .
For moldings, extrusions, rods, sheets.

SARAN . . .
For moldings, extrusions, pipe, tubing, monofilaments; also available as Saran Film.

ETHOCEL . . .
For moldings, extrusions, coatings; available also as Ethocel Sheeting.

DOW
PLASTICS
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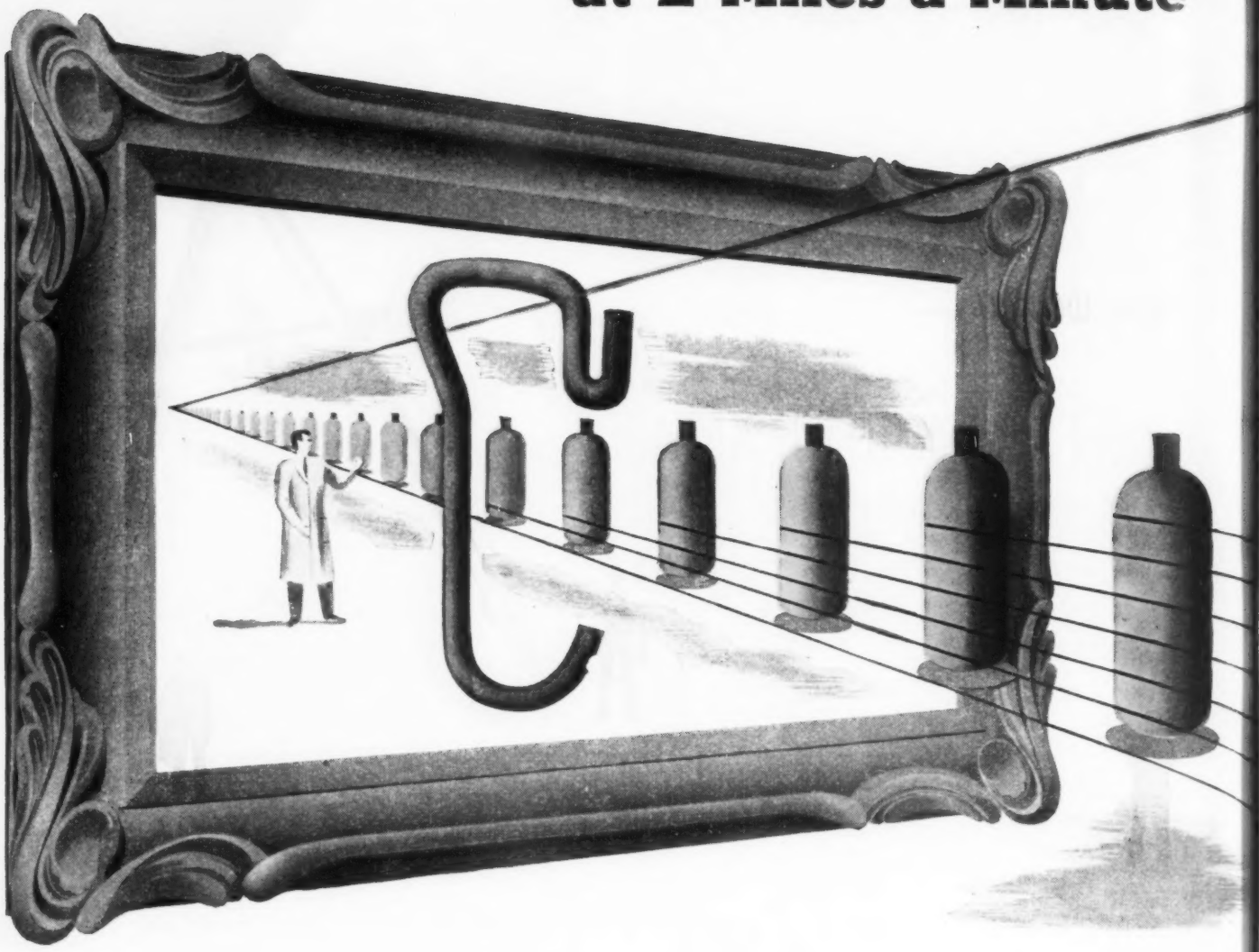
How to Defy Frictional Heat at 2 Miles a Minute



INSIDE RIVERSIDE—*Sometimes selection of the right metal for a job is a snap. Usually it takes the nature of an investigation into specific properties, machinability and workability. Very often, selection brings to bear all the services we have: complete laboratory facilities, research by our technical staff, control of product through tests, grain structure photography, long experience with the application, control and inspection of the metal right down to shipping. And to all these services Riverside adds an interested way of doing business we believe you'll like.*

IN CERTAIN worsted spinning machines a tiny gadget called a "ring traveler", riding a steel ring, guides the yarn. The traveler is pulled by the yarn actually 1½% to 2% slower than the spindle's speed.

• 4000 to 5000 r.p.m. was about tops in spindle speed. One spinner decided to double it. But at 9000 r.p.m.—2 miles a minute around the ring—the heat of friction (400° F.) drew the temper of the usual ring travelers, softened them so they soon wore out. When things looked darkest, the spinner hit upon beryllium copper.

• Beryllium copper *hardened* instead of softening at frictional heat, lasted 3 or 4 times as long. It was so smooth, the yarn didn't get "skinners" with the first doff. It made high speed spinning practical.

• What can be done with beryllium copper, or with nickel silver or phosphor bronze—Riverside's other alloys—is, however, only one side of Riverside's complete and interested service. Care for a look at the others?

RIVERSIDE

THE RIVERSIDE METAL COMPANY

RIVERSIDE, NEW JERSEY

RIVERSIDE PHOSPHOR BRONZE ALLOYS—Copper-tin alloys to which phosphorus is added. Produced in a variety of wrought and malleable alloys, special leaded mixtures, and in non-malleable cast and turned rods for bearings and bushings.

PROPERTIES—Wide range of tensile strengths and hardnesses. In general, phosphor bronze is a good electrical conductor, non-magnetic, and has a low coefficient of friction. It is easy to machine, can be welded by carbon or metal arc (there's a special alloy for flame welding), can be brazed or soldered. Easy to punch, draw, stamp, or spin. Phosphor bronze is rustless and resistant to corrosion, fatigue and wear. Supplied in sheets, strips, wire, rods, circles, bars, blanks or ingots.

Typical uses for Riverside Phosphor Bronze

RIVERSIDE NICKEL SILVER ALLOYS—A combination of copper, nickel and zinc in various proportions. Produced in a variety of alloys, tempers and anneals, and in free-cutting alloys.

PROPERTIES—Vary according to alloys. Tensile strengths up to 160,000 p.s.i., elongations up to 50%. Nickel silver is valued electrically for its specific resistance, and physically because of its clear-through silvery white appearance. In general, it is tough, resistant to wear, fatigue, and corrosion. Easy to machine in any manner, weldable by *all* methods, can be brazed or soldered and is extremely workable. Readily formed, bent, drawn, stamped, punched, embossed or spun. Supplied in sheets, strips, wire, rods, circles, bars, blanks and ingots.

Typical uses for Riverside Nickel Silver

RIVERSIDE BERYLLIUM COPPER—an alloy with an unusual combination of properties—Unusually high strength. Excellent hardness, wear resistance and corrosion resistance. High thermal conductivity, good electrical conductivity. Easy to braze, solder, punch, draw or stamp. Can be cold worked. Outstanding for hot working qualities. Can be easily hot forged or hot pressed between 1050° and 1425°F., and heat hardened to achieve strengths rare to non-ferrous metals and alloys. Supplied in sheets, strips, wire, rods, bars and blanks, usually, semi-hard, cold worked for fabrication and heat treatment.

Typical uses for Riverside Beryllium Copper

Also special alloys of copper, zinc and tin for specific purposes

PHOSPHOR BRONZE
NICKEL SILVER
BERYLLIUM COPPER

CABLE ADDRESS "SUNTOOL" LIEBERS LATEST CODE

SUNDSTRAND MACHINE TOOL CO.

LATHES MILLING MACHINES CENTERING MACHINES GRINDERS
HYDRAULIC PUMPS AND SPECIAL MACHINERY

ROCKFORD, ILLINOIS
U.S.A.

June 21, 1944

Richardson Company,
Melrose Park, Illinois

Attention: Glen M. Neely

Dear Mr. Neely:

During the past five years, we have used your Insurok Grade C. G. as gibs and retainer plates on the high speed pneumatic sanders of our manufacture.

These sanders are used on practically every type sanding and finishing operation and are given considerable abuse on heavy work.

The gibs and retainer plates of your Insurok material have proven so successful for our purpose that we have yet to receive our first replacement order for either of these parts from our users. In our opinion, this is indeed a record to be proud of, and we feel highly justified in congratulating your engineers for the fine cooperation they have extended to us in our selection of this material for these parts on our machine.

It is obvious that we will find many more uses for your Insurok material in our development work here in the Pneumatic Machine Division of this company, and you may be assured that we will again call on you for your recommendations.

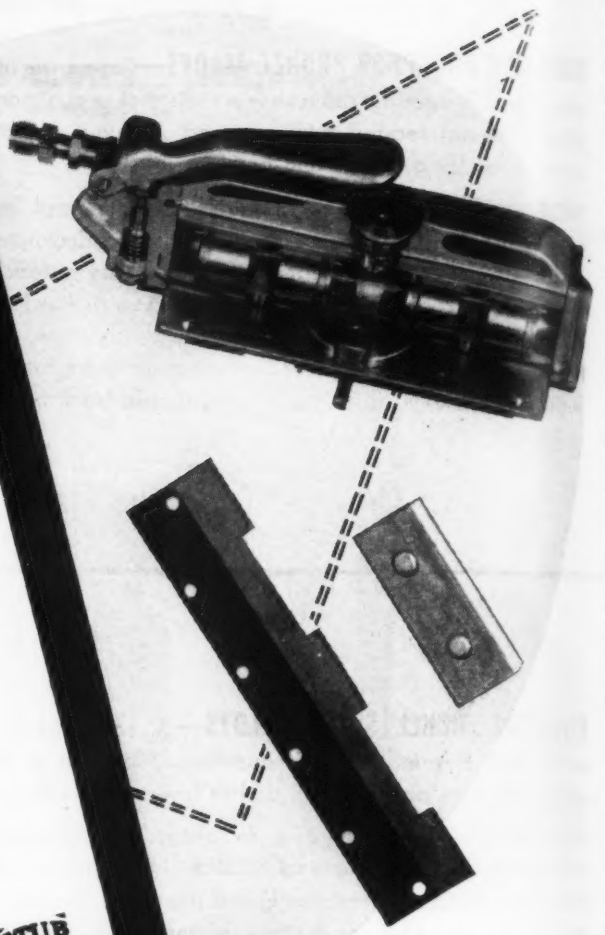
With kindest, personal regards, I am

Yours very truly,

SUNDSTRAND MACHINE TOOL CO.

Sales Manager Pneumatic Machine Division

STUB



Go Ahead!

WE DON'T MIND IF YOU READ OUR MAIL

For it points out facts that we already know . . . and want you to know.

Five years ago, Sundstrand installed gibs and retainer plates made of Laminated INSUROK in their pneumatic sanders. And in those five years, not one replacement was needed for these two vital parts. Some of these sanders worked in water . . . some in solvents . . . others finishing dry woods and metals.

Yet this is not a strange story with Laminated INSUROK. For parts made of INSUROK are ready, willing, and able to take the abuse of hard work.

There are many grades and types of Laminated and Molded INSUROK. And Richardson Plasticians combine years of experience with the working knowledge of designers and manufacturers . . . a combination which allows INSUROK to meet practically every industrial requirement. Richardson will be glad to work with you in redesigning an old line of products, or in designing the needs of a new line. Write for complete information.

INSUROK *Precision Plastics*

The RICHARDSON COMPANY

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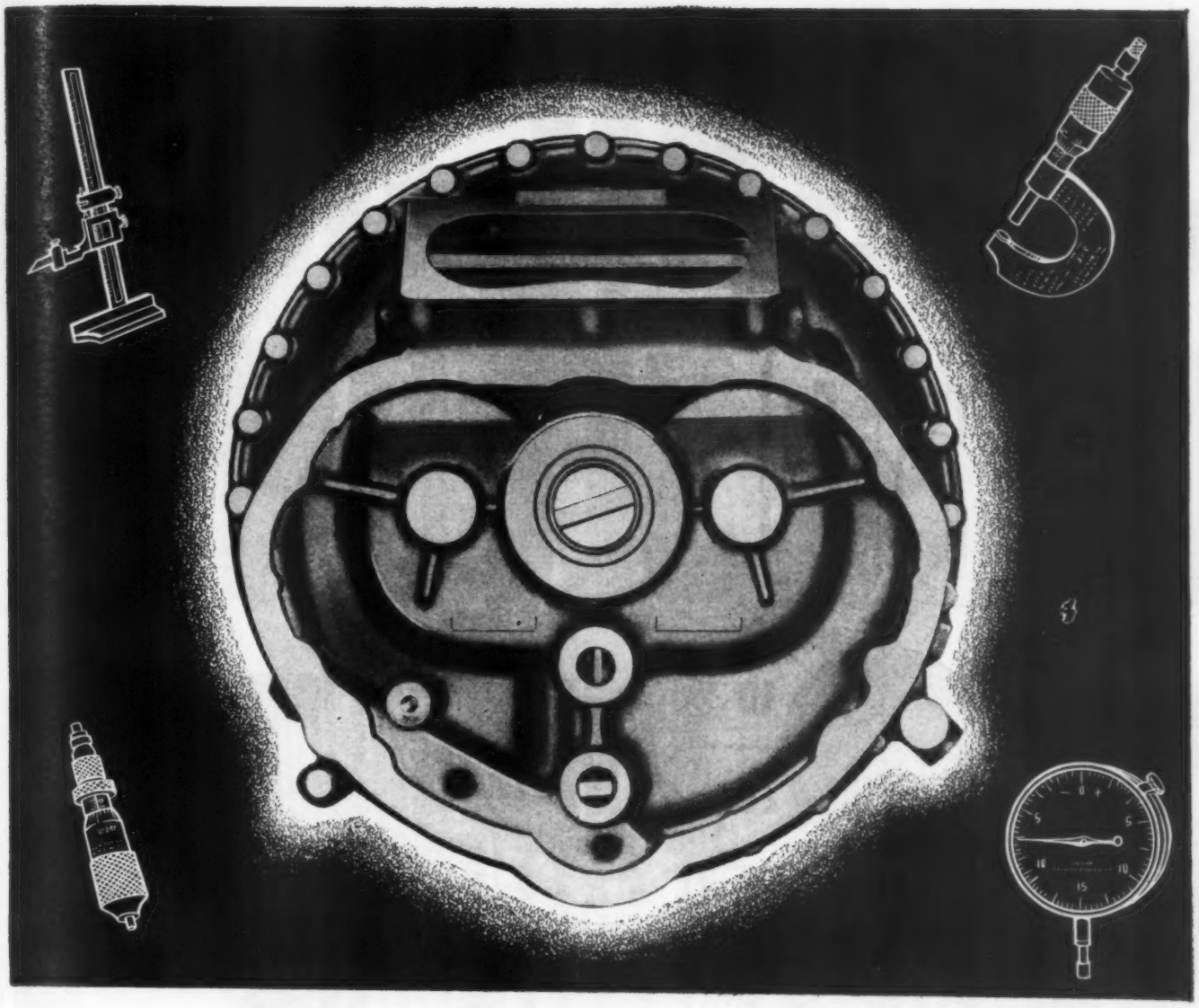


Buffalo Precision Patterns

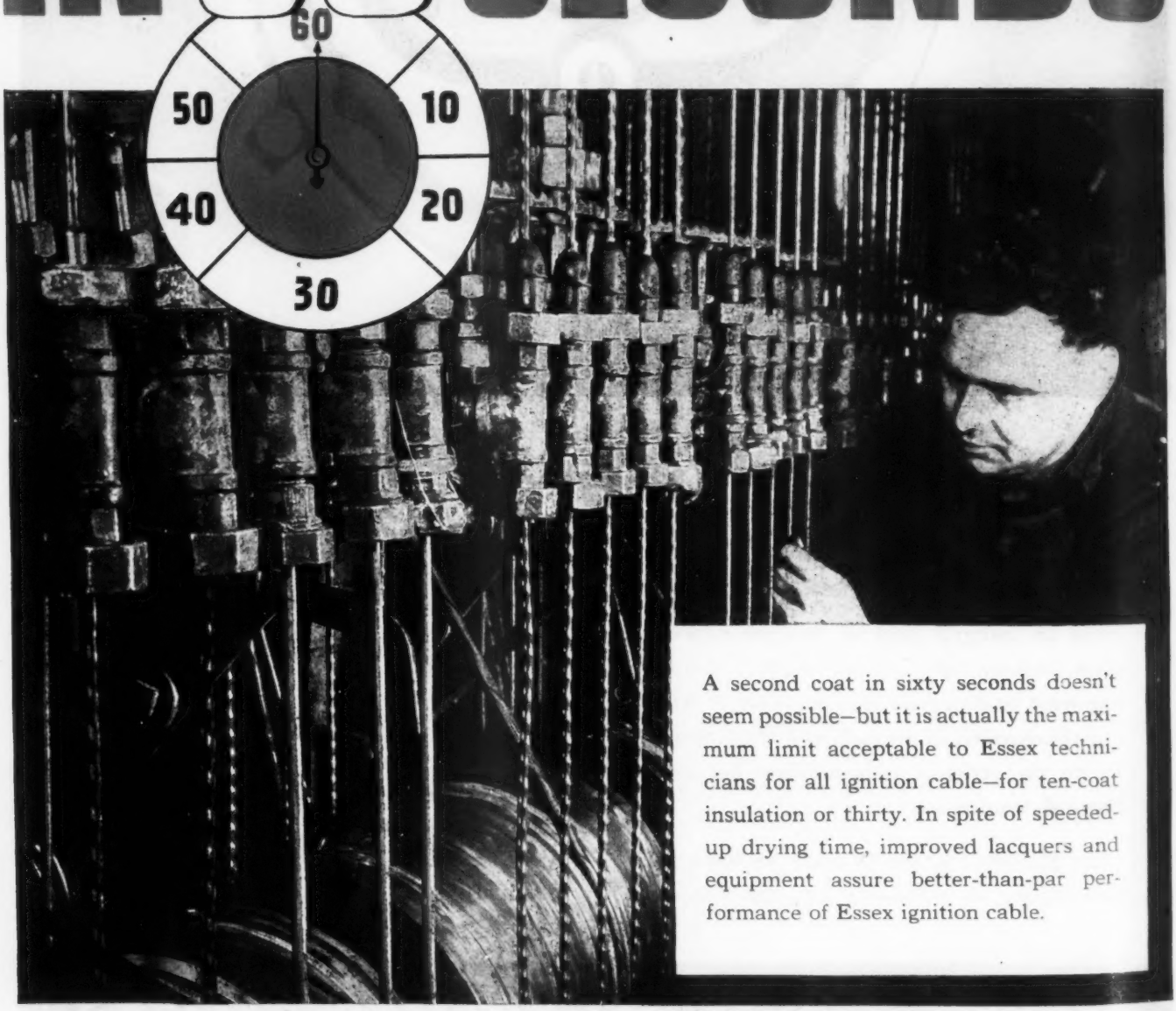
Pictured is another intricate casting made from a Buffalo Precision Pattern.

As an integral part of one of America's most famous fighter plane engines, this casting *must* be dimensionally accurate to within one-thousandth of an inch and *must* measure up to the strictest requirements for metallurgical soundness.

At Buffalo Pattern Works, we have been specializing in precision patterns for over half a century. Our skill and wide experience with metals, structural design and practical fabrication are sound reasons why we have been privileged to develop extremely difficult patterns for many of America's leading companies.

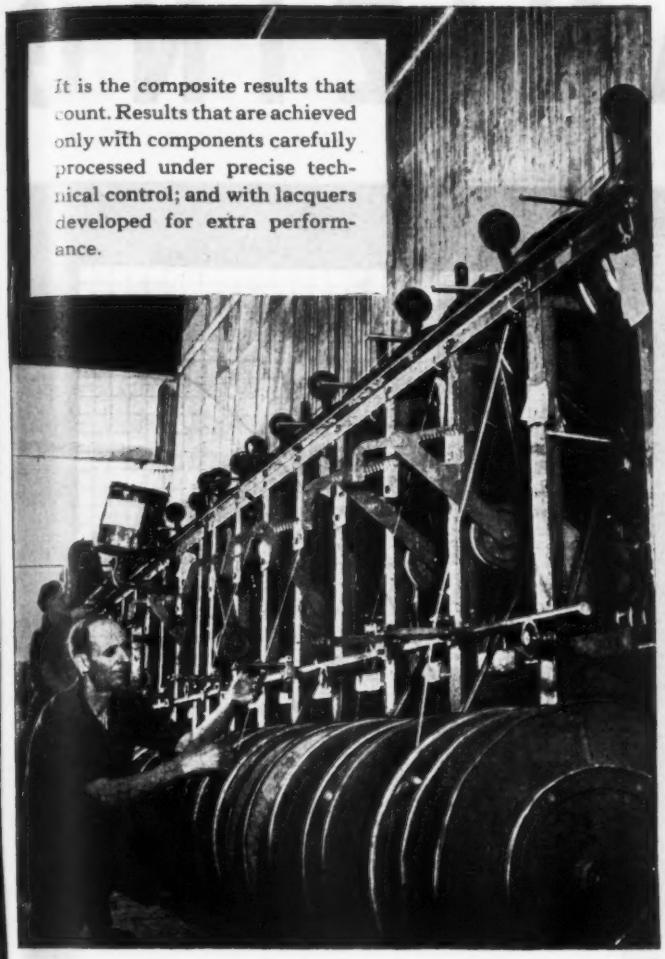
We invite you to consult us concerning your present or postwar pattern problems. Get the benefits of "Buffalo" precision. Write or wire Dept. D today for complete information.

SECOND COAT IN 60 SECONDS

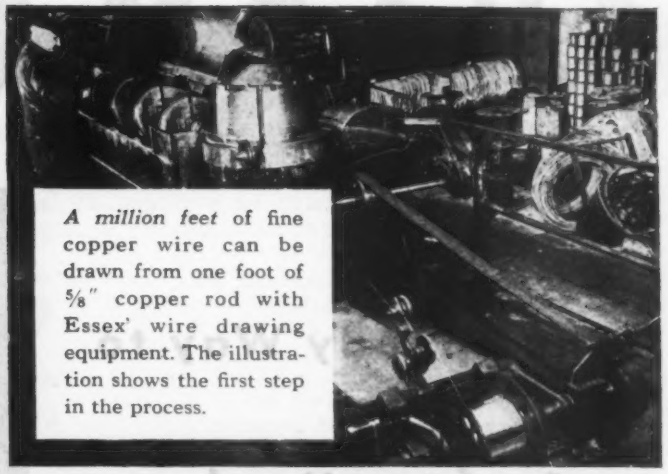


A second coat in sixty seconds doesn't seem possible—but it is actually the maximum limit acceptable to Essex technicians for all ignition cable—for ten-coat insulation or thirty. In spite of speeded-up drying time, improved lacquers and equipment assure better-than-par performance of Essex ignition cable.

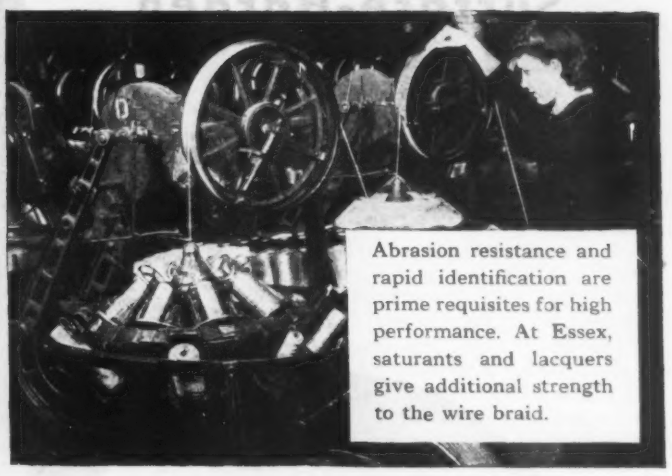
SHERWIN-WILLIAMS



It is the composite results that count. Results that are achieved only with components carefully processed under precise technical control; and with lacquers developed for extra performance.



A million feet of fine copper wire can be drawn from one foot of ⅝" copper rod with Essex' wire drawing equipment. The illustration shows the first step in the process.



Abrasion resistance and rapid identification are prime requisites for high performance. At Essex, saturants and lacquers give additional strength to the wire braid.

Essex Wire Corp. and SHERWIN-WILLIAMS speed up lacquer-coating of wire

Military demands have been many times greater and far more exacting than peace-time requirements of wire and cable. The government put in rush orders for miles and miles of insulated copper wire. RUSH! MORE WIRE! BETTER WIRE! Much of the wiring was to be subjected to rough handling. New flame-proof types of coating had to be developed. That meant various thicknesses of insulation—as many as thirty coats of lacquer—depending upon the job to be done.

Multiple coats meant speed and MORE SPEED in the drying time between coats.

Sherwin-Williams gave Essex invaluable assistance by quickly supplying new, improved or completely revamped lacquers that cut drying time between coats to approximately one minute. These improvements enabled Essex Wire to supply our armed forces with cables of highest performance—without increasing production costs!

Just another instance when Sherwin-Williams was able—and willing—to pass on the accumulated experience of its staff of finishing experts. The Industrial Finishing Division of Sherwin-Williams was founded to help industry solve its finishing problems; and its fund of know-how is at your disposal. The Sherwin - Williams Company, Cleveland 1, Ohio.

INDUSTRIAL FINISHES

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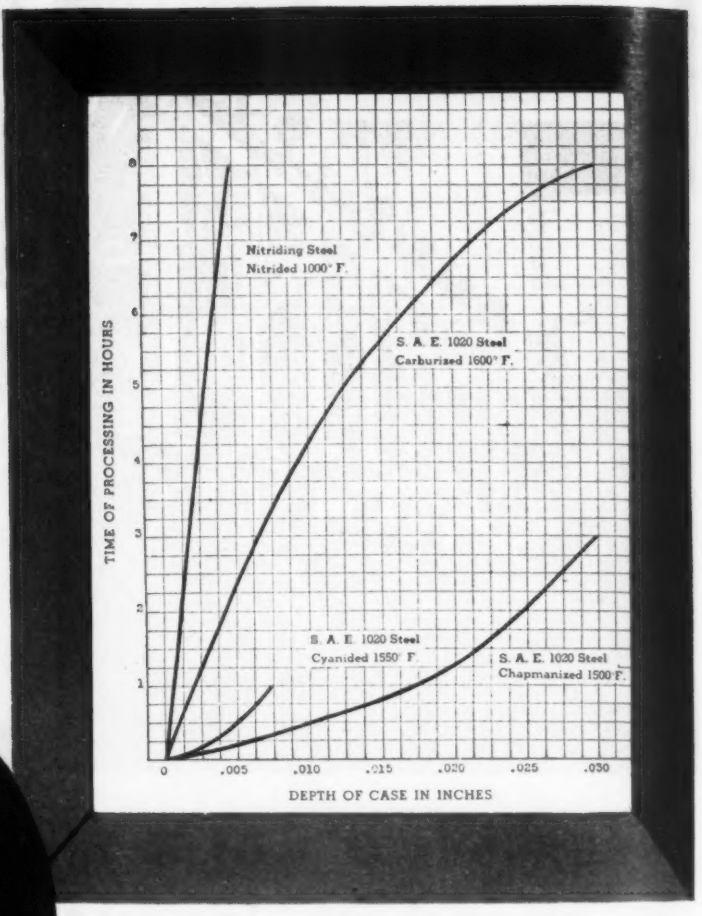
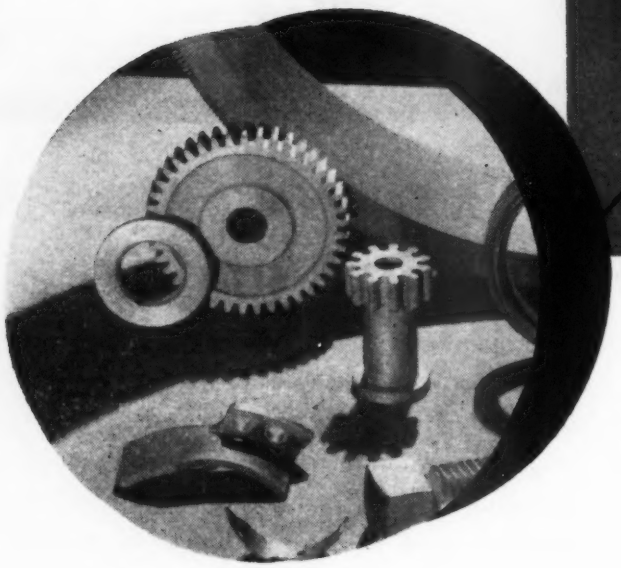
The Speedy Way to Surface-Harden Free Machining Steels





Waiting for scarce and critical alloys can frequently be avoided by Chapmanizing your free machining steel parts. Chapmanizing provides an alloy-like surface-hardness in from one to four hours, producing a case of from .002″ to .035″, so tough and ductile that it won't chip, check or warp. Parts come out silver clean and uniformly hard. Distortion, warping and growth are so controlled that finish-grinding time is reduced to a minimum.

You may send your parts to the nearest Chapman licensee, or process them in your own plant on a contract basis (by simply hooking up Chapmanizing units to your present pot-type furnaces).

Send for complete details to the Metallurgical Sales Division of

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Advertisement

JANUARY, 1945

COPPER ALLOY BULLETIN

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared Each Month by the Bridgeport Brass Co. "Bridgeport" *Headquarters for BRASS, BRONZE and COPPER*

Outlook for 1945

Future of Copper-Base Alloys is Bright... Newer Alloys Set Modern Engineering Standards

Intensive research and development on copper-base alloys in the last decade has completely changed the picture for brasses and bronzes. Where once the application of these materials for engineering purposes was limited because of moderate strength and the possibilities of stress corrosion cracking, the new alloys, some of which comprise silicon bronzes and aluminum bronzes, are of a far superior nature. Tremendous strides have been made, and development engineers and product designers should carefully study the properties of the new copper-base alloys. They will find themselves outdated if they stick to the old metal specifications. Alert designers are, therefore, carefully considering existing products with a view toward modernizing them by replacing weaker materials with modern copper-base alloys.

Silicon Bronzes for Cold Upsetting

Cap and machine screws and bolts made from copper silicon alloys (DURONZE V, for example) average over 100,000 pounds per square inch in tensile strength on most sizes. This results in a product which is about 50% stronger than ordinary low carbon steel bolts, which average about 70,000 pounds per square inch or less, in tensile strength. Since silicon bronze bolts are not subject to stress corrosion cracking, and are far superior to steel in corrosion resistance they are used for outdoor and other types of exposed construction, in place of materials which rust away, or are apt to fail from season cracking. Silicon bronze bolts are also used submerged in water or buried in the soil—conditions which destroy ordinary materials. From an engineering standpoint, the use of silicon bronzes as outlined above means less maintenance and much greater freedom from failure.

From a fabrication standpoint, the silicon bronzes offer no special problems. Bolts are made from wire by cold heading and roll threading with the same equipment as used for making steel bolts. Alloys, such as DURONZE V, are very malleable even in the form of hard drawn wire used for making cold headed products. Furthermore, cold headed DURONZE V parts do not require intermediate and final heat treatments because they are less susceptible to overworking. Because of the saving in scrap, the tendency is toward fabricating by the cold forming or upsetting process. Nuts are also being manufactured by the upset process. When silicon bronze is used for making cold upset nuts, the final product is remarkably strong and practical.

Aluminum Bronzes for Machining and Hot Forging

Aluminum Bronzes, such as DURONZE III, have shown so great a promise in the last few years that their future is assured. It seems only yesterday that such alloys were in disfavor by brass companies because of the difficulty encountered in making them. Although the fine properties of aluminum bronzes have been known for many years, the old fashioned pit-fired furnaces, with temperature controlled by natural draft, were entirely unsuited for melting these alloys because of danger from oxidation. Moreover, because aluminum bronzes are stronger and tougher than the brasses, more powerful machinery is required to process them. Up-to-date brass mills equipped with modern electric melting furnaces and powerful rod and tube extrusion presses, tube reducing machinery, huge draw benches and gigantic hot and cold rolling mills are now in a position to produce these alloys.

DURONZE III, a silicon aluminum bronze containing 91% copper, 7% aluminum and 2% silicon, is about 50% stronger than Naval Brass rod in the annealed condition. In other words, it has a tensile strength of about 90,000 pounds per square inch as compared with approximately 60,000 pounds per square inch for Naval Brass (minimum). The greater tensile and yield strengths, higher hardness values and greater fatigue limits are a combination of properties much sought for by engineers. In addition, aluminum bronzes are more corrosion resistant than brasses. Moreover, when in contact with moving parts made from steel or other materials, aluminum bronzes offer less friction, with consequently less wear. They have less tendency to gall and are excellent for the manufacture of valve stems, gears, pinions, pump parts, solderless connectors, high strength bolts, marine hardware, etc., where both strength and corrosion resistance are needed.

The use of aluminum bronzes in combination with steel parts has reduced maintenance because of less wear and corrosion. In many cases the parts made from DURONZE III, for example, have outlasted former materials six to one and even more. This alloy is supplied in rod form and can be made into high strength screw machine parts because it machines from 50% to 70% as rapidly as free cutting leaded brass rod. DURONZE III can also be readily hot forged. Such forgings average about 85,000 to 90,000 pounds per square inch tensile strength as compared to about 50,000 pounds per square inch for hot forged brass.

Reducing Dead Weight with Aluminum Bronzes

Because DURONZE III is stronger and lighter than brass, it is possible to replace Naval Brass rod with this alloy, at a saving of from 40% to 50% in dead weight, without sacrificing tensile or yield strength. DURONZE III, for the same sizes, is about 9% lighter in weight than Naval Brass. Wherever dead weight is a factor, such as on ships, planes, trains, elevators and moving machinery, many parts can be replaced by smaller and lighter parts of equal strength made from DURONZE III. This saving in weight can be utilized for carrying a paying load. No doubt there are many other items in addition to the above where weight saving is desirable.

Advantages of Copper-Base Alloys

The war with its insatiable demand for copper, brass and bronze has made it necessary to use substitute materials when copper has not been available for the less essential purposes. The fine properties and ease of workability of copper-base alloys are now appreciated more than ever.

Every manufacturer is interested in materials which will both serve the purpose intended, and yet be easy to work or fabricate. To keep production running smoothly he must have uniform material exactly suitable for his operations, and free from blemishes. Also he requires a material which will not wear out his tools too rapidly and increase his costs. These factors will be more important than ever in the postwar period because as labor costs rise, manufacturing methods must become more efficient. Close cooperation between the brass mill and the consumer can do much toward encouraging the use of the most efficient materials for fabrication. Most of the desirable qualities listed below can be found in a single copper-base alloy.

1. Wide range of physical properties controlled by simple processing operations.
2. Corrosion resistance.
3. Dependable, satisfactory service.
4. Great strength and hardness.
5. High heat conductivity.
6. Resistance to fatigue, abrasion and wear.

(Continued on page 2, column 2)

CAUSES OF CORROSION

This article is one of a series of discussions by C. L. Bulow, research chemist of the Bridgeport Brass Company.

ACCELERATED CORROSION — COLD WALL EFFECT

In the previous issue we discussed the "hot wall effect" and showed that the liberation of a gas or precipitate on a hot metal surface might lead to severe localized corrosion. We shall now consider the "cold wall effect" which is encountered wherever condensation occurs on a cold metal surface.

Industrial Importance of Cold Wall Effect

The condensation of a vapor or gas to a liquid on a cold surface is a physical change of considerable industrial importance. At times this phenomenon may cause annoy-

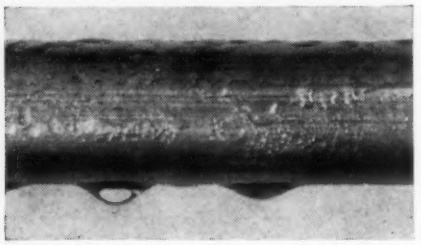

Fig. 1—Condensate collecting on cold tubing.

ance as in the case of the "sweating" of cold water pipes.

The condensation of exhaust steam on the surfaces of tubes in surface condensers used in conjunction with steam turbines is an important step in the economical production of electric power. In the chemical and petroleum industries, many millions of feet of tubing are used in the form of condensers and heat exchangers to change various gases such as gasoline, the alcohols, acetates, ketones, et cetera, into the liquid state. In most of these applications, the copper-base alloys give excellent service. For example, steam and alcohol usually corrode these alloys at rates less than 0.0001" per year. On the other hand, under unusually severe conditions, encountered in the production of gasoline and certain chemicals, the corrosion rate may be as high as 0.0005" up to 0.050 inches per year.

Corrosion Associated with the Cold Wall Effect

The condensation of water vapor on a cold metal surface leads to the formation of droplets of water as shown in Figure 1. Under most conditions, these droplets form,

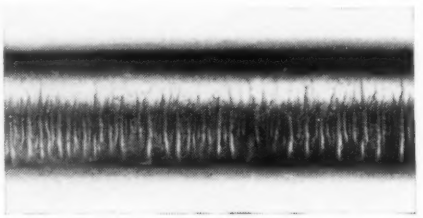

Fig. 2—Corrosion grooves produced by corrosive condensate.

grow and roll off the tube without producing any noticeable amount of corrosion. Occasionally, an unusual situation is encountered where the water droplet has absorbed small amounts of corrosive materials such as hydrochloric acid, ammonium hydroxide, sulphur dioxide, etc., which may lead to the formation of deep corrosion grooves in the side of the tube as illustrated in Figure 2. This occurs where the droplets of water form repeatedly at the same spot and roll down the same area on the tube surface. This may also take place where two immiscible liquids condense side by side. Sometimes, considerable longitudinal grooving or pitting may occur on the bottom side of the tube where the droplets of corrosive liquid may hang for some time before dropping off. Usually considerably more thinning of the tube wall occurs on the bottom side of the tube as compared with the top side. An acid condensate flowing down the side of a sheet of metal may in time also produce long, deep, corrosion grooves.

Outlook for 1945

(Continued from page 1)

7. Fine spring qualities.
8. High electrical conductivity.
9. Pleasing color.
10. Non-magnetic.
11. Ease of finishing, plating, lacquering.
12. Ease of cold and hot working.
13. Machineability.
14. Ease of brazing, soldering, welding.

Research and Development

Many new alloys and improved old ones are resulting from the work done by research departments in brass mills. This work has been stepped up during the past few years. A consistent program of research has brought forth much new information regarding the corrosion resistance and physical properties of standard brass mill alloys. This puts the metallurgist in a better position to help the designing engineer to select the alloy best suited for the purpose. Continued improvement in the quality of basic materials makes possible lower costs in mass production of precision quality products.

Every manufacturer will benefit by closely examining every possibility of using copper-base alloys for better performance and easier manufacture in the fields of transportation, housing, communications; manufacturing and chemical processing plants, oil refineries and many others. Since dependability and satisfactory performance are most important engineering requirements, the future of the copper-base alloys has never been brighter.

NEW DEVELOPMENTS

This column lists items manufactured or developed by many different sources. None of these items has been tested or is endorsed by the Bridgeport Brass Company. We will gladly refer readers to the manufacturer or other sources for information.

Copper Plating Process to reduce costs and increase speed. The process substitutes small amounts of potassium cyanide and other potassium salts for sodium cyanide. Makers of tanks, planes, motorized equipment and other military items are reported to use it for plating numerous engine parts and other items requiring a copper plate. (586)

A New, Non-Destructive X-Ray Diffraction Unit can be used with the new low-angle-scatter cameras or other standard types of photographic equipment. Utilizing full wave rectification, the new equipment is expected to prove invaluable in welding, casting, forging, etc. (587)

A New Type Metallizing Gun, developed for high-speed production spraying of low melting point metals. It is said to be capable of using 1/8 in. zinc, tin, lead, solder, babbitt, cadmium, or fine gage copper and its alloys. A patented controlled power unit provides efficient automatic spraying hour after hour. Air pressure fluctuations are reported not to affect its operating efficiency. (588)

A Small Barrel Plating Unit for handling such small pieces as springs, catches, rings, pins, screws, etc., has a capacity of 2 gals; may be used for copper, nickel, brass, silver, etc. It consists of adjustable cathode and anode, and a slowly rotating tilted tub. The power unit electric motor can be plugged into any convenient outlet. (589)

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WELDING ROD—For repairing cast iron and steel, fabricating silicon bronze tanks.

LEDRITE* ROD—For making automatic screw machine products.

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COPPER WATER TUBE.

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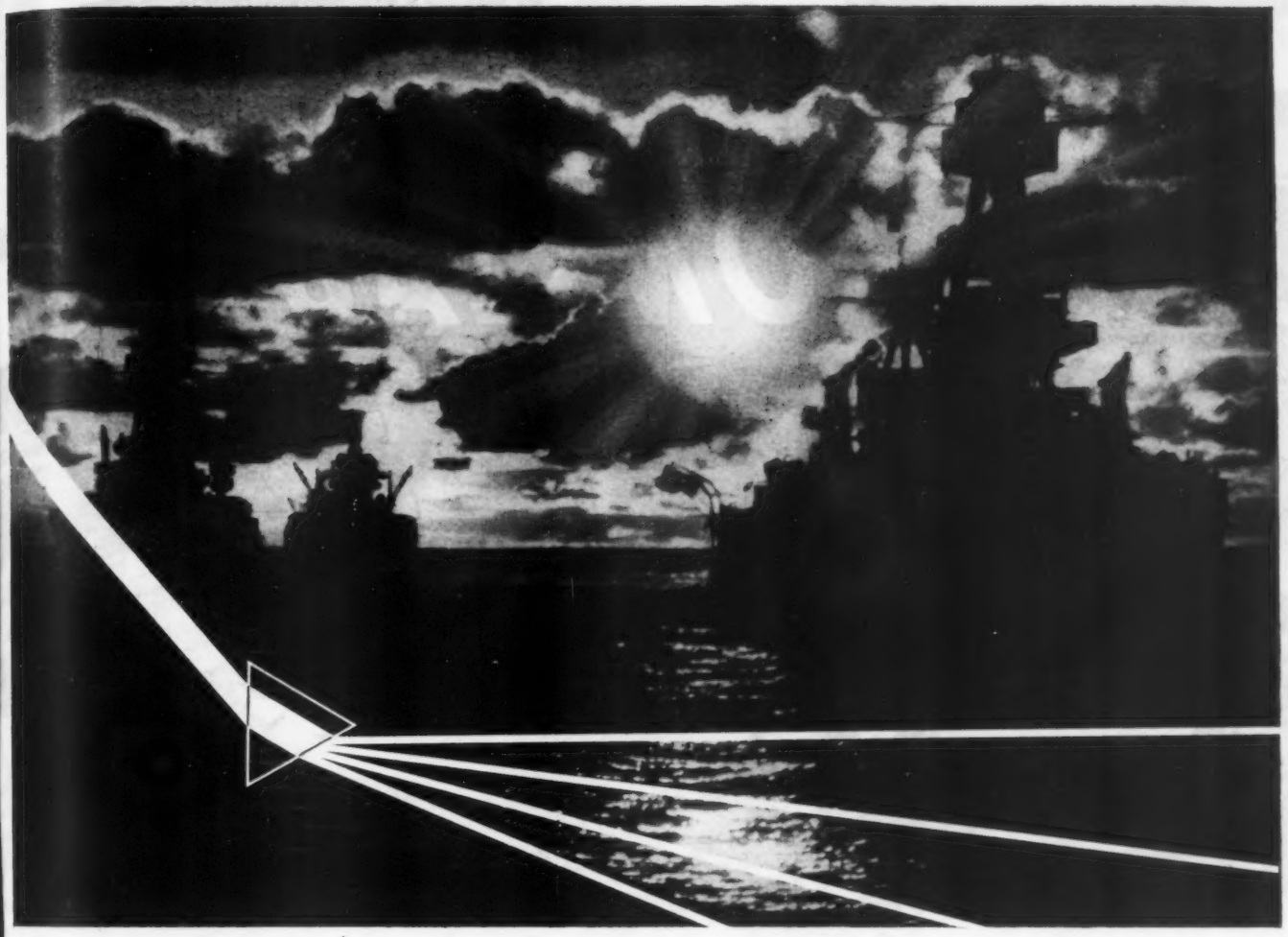
BRASS AND COPPER PIPE

Note: Bridgeport products are supplied in accordance with existing priority regulations.

*Trade name.

BRIDGEPORT ARMY E NAVY **BRASS**



Some of the smaller things on a battlewagon

When enemy planes are in the skies, the survival of our great battleships often depends upon the accuracy of a handful of tiny pieces of glass. These are the optical components of the anti-aircraft fire control instruments. They must be as nearly perfect as the most advanced techniques can make them.

No wonder the Bureau of Ordnance of the United States Navy is so particular in the selection of these optics upon which the safety of our ships and men depends. Very few manufacturers have been able to meet the rigid naval specifications for parts like these.

Our technicians and craftsmen are justly proud that they can grind and polish glass to the exacting naval requirements. This compact group of precision lens specialists has been busy all through the war supplying our armed forces. They are looking forward to the time when they can apply their war-improved skills to the production of equally fine products for peace.

The plant in which they work has always been solely devoted to producing precision optics for other manufacturers. No other products are made here. If you have a post-war problem in optics you will find the kind of help you need in this modern, well-equipped plant.

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Out of America's great manufacturing industries—out of the coordinated teamwork of engineers, technicians, metallurgists, material processors and production men—has come the mechanized might that will crush the Axis. It is an *onslaught of steel*, launched against the enemy by fighting men whose skill and courage make victory inevitable.

Much of the steel that goes into this fighting equipment flows from the mills of the Great Lakes Steel Corporation: *N-A-X High-Tensile Steel* for highly stressed structural parts and members subject to fatigue and impact—*N-A-X 9100 Series Steels* for constructional parts—*N-A-X Armorplate* for rugged armored equipment of all types. From the earliest tanks built, to the recently announced Staghound, armored with *N-A-X Armorplate* exclusively, Great Lakes Steel Corporation has played a vital role in supplying our land, sea and air forces.

Proved in the stern test of battle, *N-A-X Alloy Steels* will speed reconversion—lend new strength, lightness and durability to postwar products.

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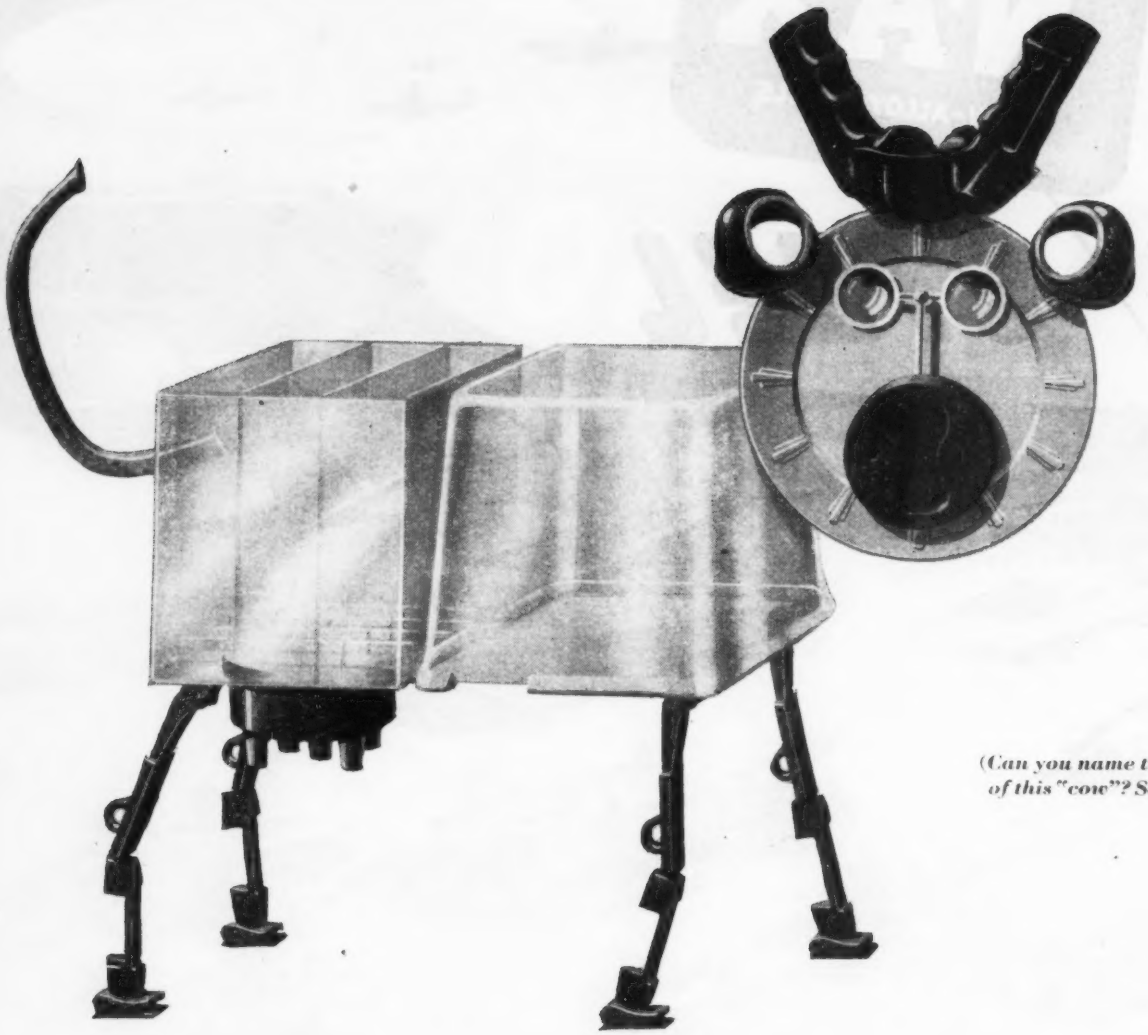


(Can you name the plastic parts of this "cow"? See chart below.)

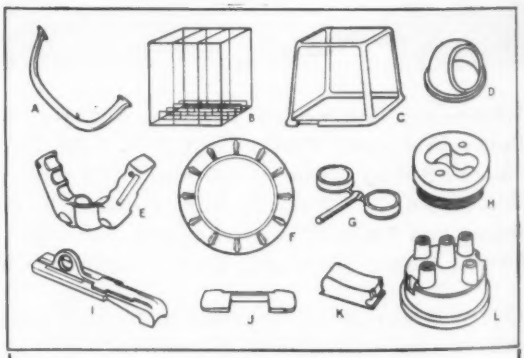
How to milk more efficiency out of your product

No need to beef over the problem of bringing out a new product or improving an old one. Continental's Plastics Division, with years of experience in planning and producing a wide variety of successful plastic products, can give you a good steer.

Our designers, engineers and research men are in close touch with the foremost manufacturers of raw materials, and will work with them to select the plastic best fitted for your requirements.*

No matter which modern fabricating techniques your product requires — compression, injection, extrusion, lamination or sheet forming—it will be handled in the most efficient and economical way.

You can count on Continental to give your product the exact features it should have—beauty, durability, lightness, toughness or anything else. You'll find an alert, progressive organization equipped to offer sound, practical advice and assistance at all times!



(a) Air scoop mounting—compression; (b) Battery case—injection; (c) Dust cover—sheet formed; (d) Mouthpiece for phone—compression; (e) Gunner's handles—compression; (f) Nursery dish—compression; (g) Flashlight lenses—injection; (h) Electrical cap—compression; (i) Power switch lever—compression; (j) Ribbon cover—compression; (k) Trigger for gun handle—compression; (l) Distributor cap—compression.

CONTINENTAL PLASTICS DIVISION

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SHEET FORMING • LAMINATION

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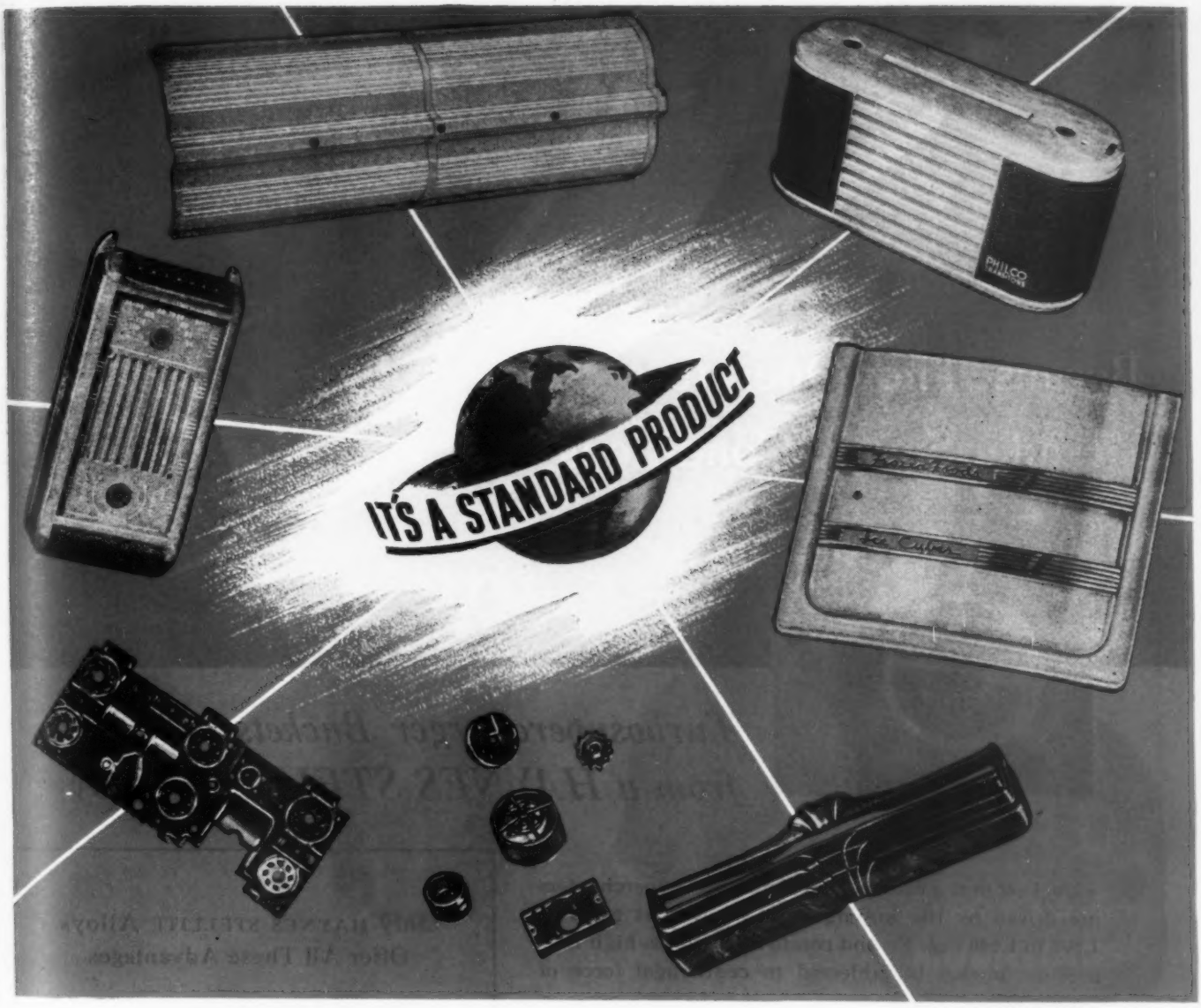

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Standard Products' reputation is an inherent part of every plastic item we fabricate, our reputation in molding plastics is not accidental—but the result of years of experience, strenuous application to detail and an honest desire to produce the best at the lowest possible cost.

The Standard Products Co. modern press equipment plus new techniques in molding all combine to assure you that the Standard Products Co. will give you the utmost in molding service . . . efficiently and economically.

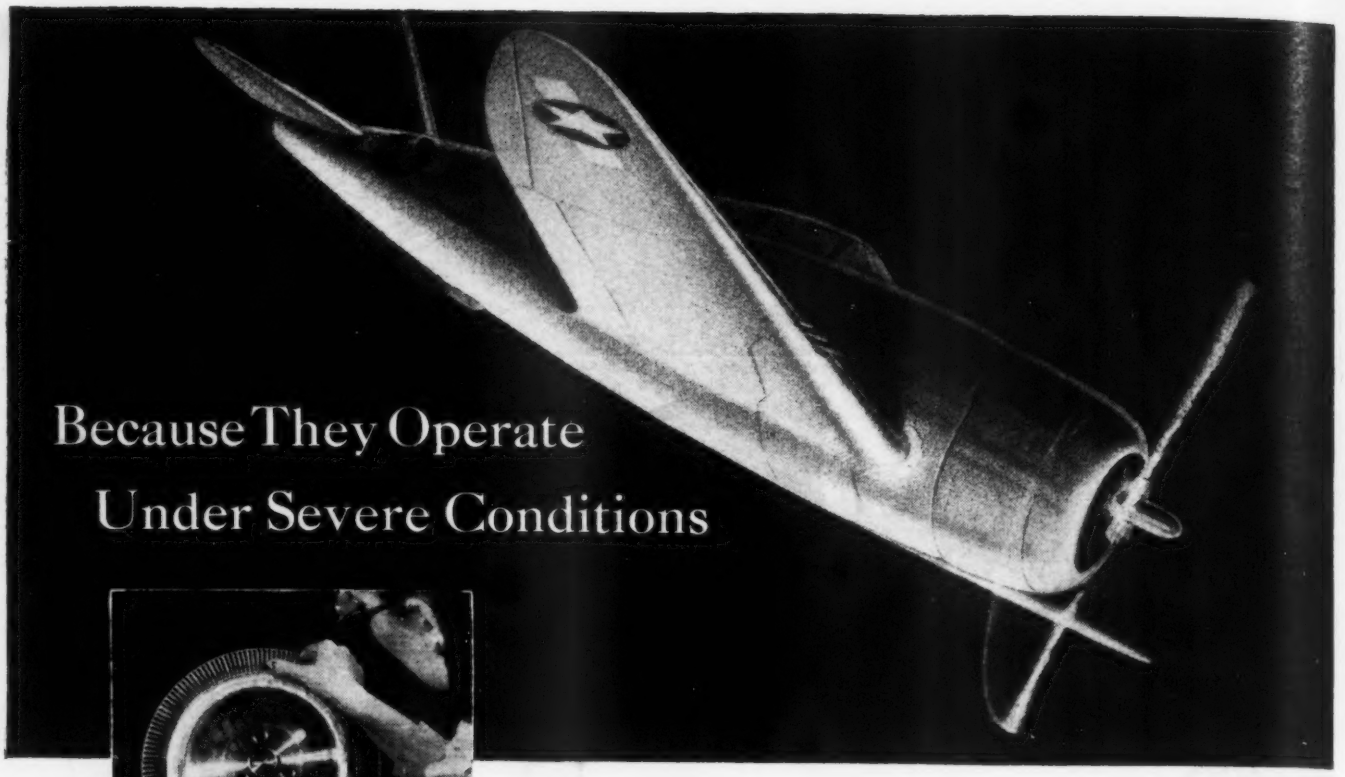
The Plastics Division of Standard Products is equipped to mold any plastic part, large or small, by injection, compression, extrusion, transfer or jet molding processes

The facilities of the Standard Products' Research Laboratory and Engineering Departments are at your service. Write the Standard Products Co, if you have a plastic molding problem.

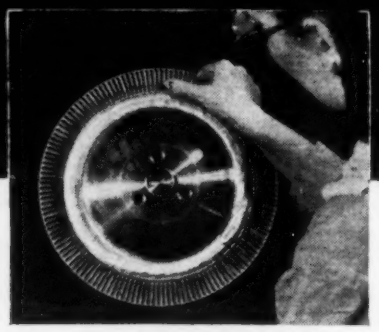
THE STANDARD PRODUCTS COMPANY

Main Offices and Research Laboratory

505 Boulevard Bldg. • Woodward Ave. at E. Grand Blvd. • Detroit 2, Michigan



Because They Operate Under Severe Conditions



Turbosupercharger Buckets are made from a HAYNES STELLITE Alloy

• Buckets in the wheels of airplane turbosuperchargers are driven by the impingement of exhaust gases at 1,500 to 1,600 deg. F., and rotate at speeds so high that a ½-oz. bucket is subjected to centrifugal force of 750 pounds.

A HAYNES STELLITE alloy is used because it withstands the severe conditions of high temperature, corrosive gases, vibration, and centrifugal stresses over long periods of time. No other economically practical metal has been found for this service.

The same properties that make this HAYNES STELLITE alloy so essential in turbosuperchargers are also important in many other applications where severe conditions of heat and corrosion are encountered.

Consider HAYNES STELLITE alloys for those jobs where other metals fail. Our engineers will help you use them economically and efficiently. Write for further information.

Only HAYNES STELLITE Alloys Offer All These Advantages

1. They resist wear and abrasion.
2. They maintain their hardness even at red heat.
3. They retain their good mechanical properties at high temperatures over long periods of time.
4. They resist atmospheric corrosion and corrosive chemicals.
5. They take and keep a high polish.
6. They have a low coefficient of friction.
7. They are practically non-magnetic.
8. They can be supplied in the form of castings, small sheets, and welding rod.

HAYNES STELLITE TRADE-MARK

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

New York 17, N. Y. UCC Kokomo, Indiana

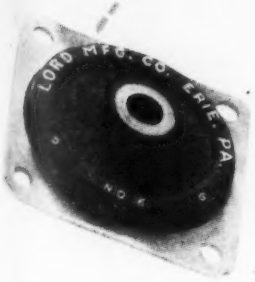
Chicago—Cleveland—Detroit—Houston—Los Angeles—San Francisco—Tulsa

RED-HARD, WEAR-RESISTING ALLOY OF COBALT, CHROMIUM, AND TUNGSTEN.

"HAYNES STELLITE" is a registered trade-mark of the Haynes Stellite Company.

The name **LORD**

On Mountings and other BONDED RUBBER Products Assures the Ultimate in Vibration Control



Every genuine Lord vibration mounting has the name "LORD" molded into the rubber section, as a means of ready identification, and as a guarantee to the user that he is receiving Lord quality.

Lord has had the best part of a generation of scientific research and experiment in the field of vibration. Lord processes and features, many of which are patented, have proven, in practically every field of industry, that they provide the highest degree of vibration isolation efficiency. Lord Mountings are bonded, rubber to metal, in a union that can't fail because the bond is as strong as the rubber. In every Lord Mounting, the size, the shape and composition of the rubber is accurately determined by the requirements of the job. In the process of manufacture, the rubber is put under no stress or tension, compression or torque, and is ready to give its full strength and resiliency to combatting the forces of vibration.

Included in this famous line of products are plate and tube form mountings, flexible couplings, engine suspensions, meter mountings and diaphragms. Special bonded-rubber products of every conceivable shape and size are produced to specification. All bear the name "LORD".

If you have a vibration problem, or a mechanical design problem involving the use of functional rubber, it may best be solved by means of rubber-bonded-to-metal. Call in a Lord Vibration Engineer, or write for literature on the subject. There is no obligation.

Do More Than Before—Buy EXTRA War Bonds

IT TAKES BONDED RUBBER *In Shear* TO ABSORB VIBRATION

LORD MANUFACTURING COMPANY
ERIE, PENNSYLVANIA

SALES REPRESENTATIVES
NEW YORK - - 280 MADISON AVE.
CHICAGO - 520 N. MICHIGAN AVE.
DETROIT - - 7310 WOODWARD AVE.
BURBANK, CAL. - 245 E. OLIVE AVE.
CANADIAN REPRESENTATIVES
RAILWAY & POWER ENGINEERING CORP., LTD.
TORONTO, CANADA

Originators of Shear Type Bonded Rubber Mountings

Fluid Power Equipment by Oilgear Wears Finishes by Lowe Brothers

The Oilgear Company of Milwaukee, Wisconsin, is a pioneer of outstanding advances in fluid power application. Oilgear Fluid Power Systems of every type are speeding production by accurate, flexible control of speeds that are steplessly variable throughout the entire range.

In brief, Oilgear furnishes a well known standard of dependable power accurately controlled for America's military and industrial might.

Over the years, Oilgear has been a consistent user of Lowe Brothers finishes for dependable protection of their products.

Oilgear, and many other makers of precision equipment, know that Lowe Brothers finishes are made as a result of thorough study of product requirements and laboratory research. This skill in manufacture assures the right product—whether it means one to stand up under cutting compounds, greases, alkalis, unusual moisture conditions, or many other varying work and exposure conditions.

And whatever your finishing problem, you may be sure that Lowe Brothers experience in serving industry is yours to command.

INDUSTRIAL SALES
THE LOWE BROTHERS COMPANY
DAYTON, OHIO

Lowe Brothers
FINISHES for Industry

Engineering IN FABRICS

Apply "engineering" to your industrial fabric requirements just as you do when you work with metal, plastic or wood . . . it performs these three important functions

- Leads to advantages gained through improved or advanced design.
- Taps the resources of the entire fabric industry to obtain the exact fabric for your requirement.
- Provides modern facilities and skilled workmanship to produce your fabric parts, accessories and products.

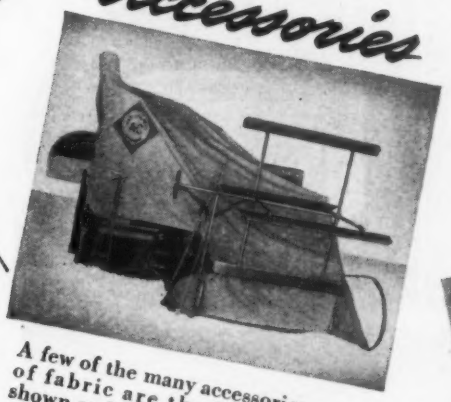
LEADS TO BETTER

Parts

Scores of fabric parts are typified by the Dust Arrestor Tube illustrated and the parts listed below.

Ducts **Conveyors**
Diaphragms **Boots**
Bellows **Tabs**

Accessories



A few of the many accessories made of fabric are the Fitted Cover shown and the following articles:

Curtains **Containers**
Cases **Tool Rolls**

Products

War-developed fabrics take the major role in the Insulated Case shown. Other typical products are:

Baskets **Tents**
Umbrellas **Tarpaulins**
Tanks **Buffing Wheels**

FABRIC PARTS when joined with parts made of other materials create important assemblies which meet industry's most rigid specifications.

FABRIC ACCESSORIES are frequently used to "round out" a major line . . . to fill a need for added protection . . . portability or convenience.

FABRIC PRODUCTS are reaching new goals through the full utilization of the improved methods of treating and coating standard cloths . . . and by the advantages gained through the application of the many new war-developed synthetic fabrics.

★ c.k. Turk CORPORATION

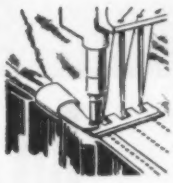
THE C. K. TURK CORPORATION
Product Development Division
333 No. Michigan Ave., Chicago 1, Illinois
Factory and Home Office: South Bend, Indiana

FABRIC-ator TO INDUSTRY

TURK'S "PACKAGED" ENGINEERING PLAN OFFERS YOU THESE SERVICES!

DESIGN...
the first step toward building functional advantages and economies into your industrial fabric parts, accessories, or products is to call in a Turk Engineer for competent design counsel.

FABRIC SELECTION...
Turk's broad knowledge and daily contacts in the field of fabrics will prove invaluable in selecting just the right fabric for your specifications.



PRODUCTION...
modern methods and machines combine with the skill of experienced workers to make the fabric products produced by Turk the very highest in quality and satisfaction.

Your new world—and MASONITE HARDBOARDS

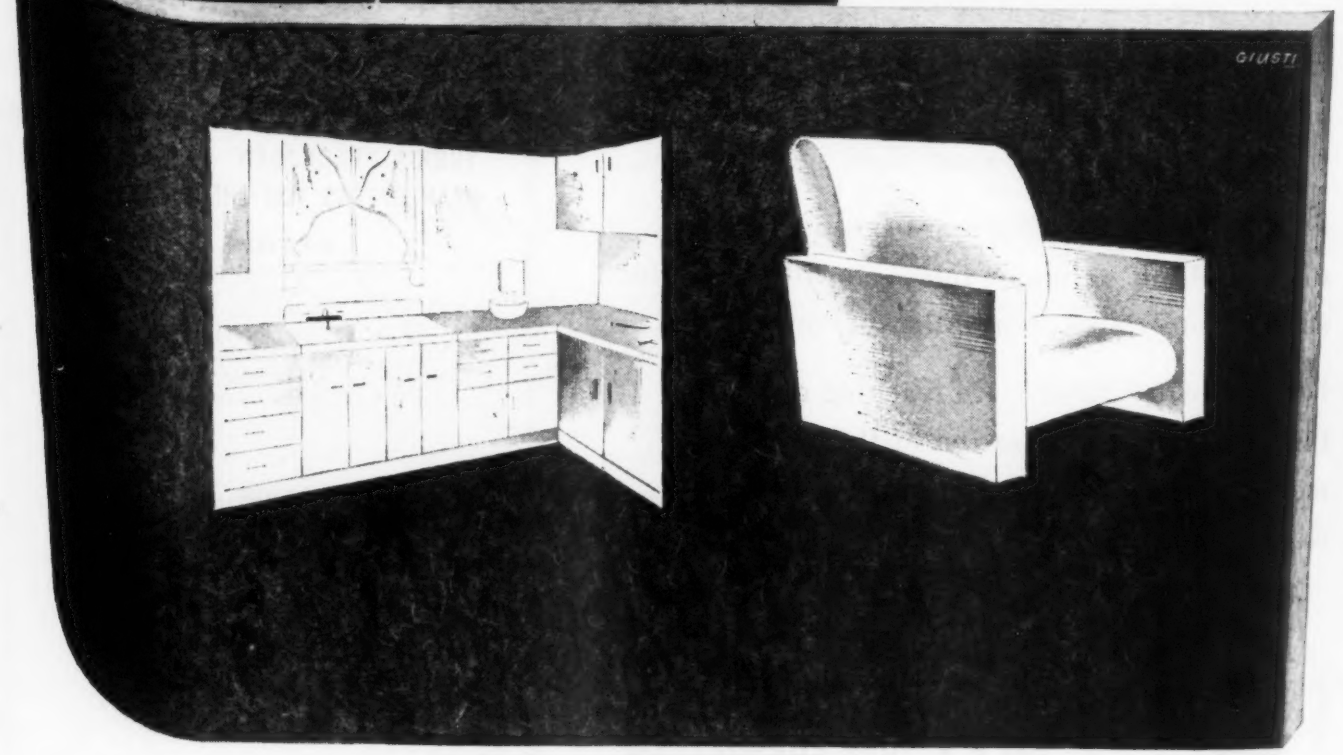
Hundreds of things being made today . . . or planned for tomorrow . . . are better because they're made in part from some of the most versatile and useful new materials ever invented—the Masonite* hardboards. To some things they bring greater strength and longer life, to others new beauty or unusual value.

Manufacturers of consumer products use these ligno-cellulose hardboards to advantage in building homes, furniture and household appliances. They find favor, too, among builders of trains, autos and passenger trailers.

In industry, their applications are almost endless. Dense, strong, grainless and moisture-resistant, they may be bent, die-cut, punched, drilled and formed. They keep their true edges and they'll take a great variety of finishes.

Discuss your plans with our engineers—they'll give you valuable technical data about the several Masonite hardboards and their uses. Address Masonite Corporation, Dept. PE-1, 111 West Washington St., Chicago 2, Ill.

*"Masonite" is a trade-mark registered in the U. S. Pat. Off. and signifies that Masonite Corporation is the source of the product.



MASONITE BRAND PRODUCTS

REG. U.S. PAT. OFF.

COPYRIGHT 1945, MASONITE CORP.

Will you join us in the conning tower?

WHAT is the future of your product after peace comes? How keen will your competition be, and what can you do to prepare against it? Because we have been privileged to assist in the improvement of many war machines by means of forgings, we have gained a fund of information you will find worth sharing.

Forged aluminum cylinder heads, forged aluminum pistons, and steel cylinder barrel forgings for aircraft engines are among the Tube Turns achievements which have been called revolutionary. Produced to highest precision standards, in large quantities, with accurate heat treating under rigid laboratory control, these products point the way to a wide range of possibilities for peacetime industry.

Whether you are concerned with the improvement of your present product, or with developing wholly new ideas, the successful experience of Tube Turns engineers is available. TUBE TURNS (Inc.), Louisville 1, Kentucky.

TUBE TURNS *Forgings for Industry*

•Laminated
•Molded
•Cast
Plastics FABRICATED by

★ FORMING ★ PUNCHING
★ SCREW MACHINING ★ HOBBING

McINERNEY Plastics Co.
Fabricator of Precise Plastic Parts and Products
Grand Rapids, Michigan

RUFKAST Goes to War on Instrument Panels

... Non-Glaring
... Large, Medium and Fine Wrinkle

Speed up war production with this new, improved Berry Brothers' Rufkast. Quick baking means more production. Strong wrinkling action protects it against shiners—results in fewer rejects. Non-glaring surface cuts down eye strain—makes the fine-pattern-dull an ideal finish for instrument panels.

Use Berry Brothers' Rufkast as a time-saving finish on radio and radar equipment.

All three patterns—large, medium and fine—can be baked with infra red equipment, as well as in gas or electric ovens. All wrinkle properly, even under high initial heat. Edges and corners wrinkle uniformly, and hardening of film continues after baking, due to oxidation of drying oil.

Infra red baking time depends upon weight of metal, but 10 minutes with 250 watt lamps is usually sufficient. Gas or electric oven baking is one hour at 250-275°.

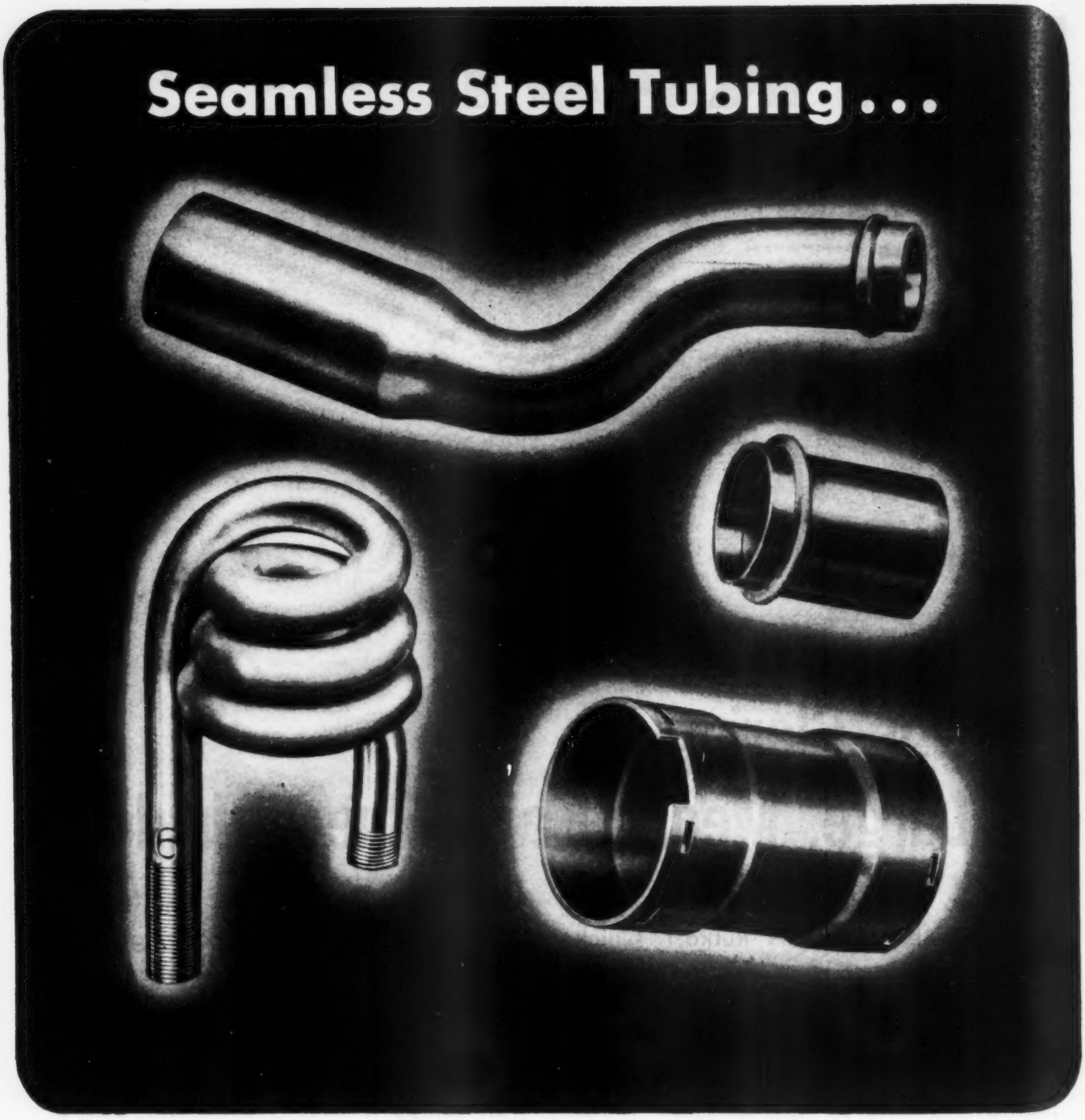
Available on low priority. Write for further information.

BERRY BROTHERS
Paints · Varnishes · Enamels · Lacquers
Detroit 7, Mich. Walkerville, Ont.

BOSTON • JERSEY CITY • CINCINNATI • CHICAGO
ST. LOUIS • INGLEWOOD, CALIF. • MONTREAL
WINNIPEG • TORONTO

QUALITY FINISHES SINCE 1858

Seamless Steel Tubing . . .



A Versatile Stock in any Plant

In the mechanical field there is practically no end to the number and variety of uses to which seamless steel tubing can be put—and profitably, too!

Designers and engineers are constantly adding to the number of parts using seamless steel tubing as raw stock. The controlled physical properties and uniform structure of seamless tubing renders it ideal for such operations as upsetting, beading, flaring, threading, swaging, bending, and forming. It also adds strength while reducing weight and eliminating many machining operations. Let Michigan Seamless engineers tell you how seamless steel tubing can serve you.

COLD-DRAWN SEAMLESS STEEL TUBING

MECHANICAL • STRUCTURAL • AIRCRAFT • PRESSURE

MICHIGAN TUBING

MICHIGAN SEAMLESS TUBE COMPANY

SOUTH LYON • MICHIGAN

ARMY E NAVY

Awarded Feb. 12, 1943
First Star Sept. 9, 1943
Second Star May 27, 1944
Third Star Dec. 2, 1944

We're cooking up New Answers in Plastics

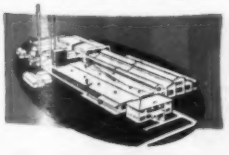
RADIO-FREQUENCY preheating is an important development in plastic molding. It makes new applications feasible and many better cures possible—and it can increase your daily production. It's something to look for when you select your plastics molder.

Look for this too. A full installation of preheating equipment is important — but complete equipment plus extended experience in its use means a whole lot more. The machines will suddenly be available to everyone after the war. The experience won't.

At Kurz-Kasch, we've been building up preheating technique since the *first* R.C.A. radio-frequency machine was delivered to us for experiment back in early 1943. We've got plenty of all kinds now, and we know how to design for them, estimate for them, and use them.

If you want this kind of progressive thinking in your molder—and want it backed up by a solid record of accomplishment dating back to the birth of the plastics industry — ask Kurz-Kasch to figure on your plastics application. Just ask for an engineer.

WHY KURZ-KASCH FOR PLASTICS? Kurz-Kasch offers a 28 year old reputation for thoroughly-engineered, quality production. • One of the largest, best-equipped exclusive custom molding plants in the country—75,000 sq. ft. of floor space with 125 compression and transfer presses of all sizes. • Complete mold-making and finishing facilities. • Extensive production sequences of radio-frequency preheating equipment, with full experience in their use. • Complete insert-production shop. • For satisfaction in plastics, key these facilities into your production line.



THE WAR BONDS YOU KEEP ARE THE BONDS THAT COUNT

Kurz-Kasch

For over 25 years Planners and Molders in Plastics

Kurz-Kasch, Inc., 1427 South Broadway, Dayton 1, Ohio. Branch Sales Offices: New York • Chicago • Detroit Indianapolis • Los Angeles • Dallas • St. Louis • Toronto, Canada. Export Offices: 89 Broad Street, New York City

How Orco can help You

ON PROBLEMS INVOLVING RUBBER AND SYNTHETIC RUBBER

DEVELOP NEW PARTS

Where component units of new products may require a combination of properties in a single material, ORCO can help you explore the possibilities of rubber and synthetic rubbers.

OBTAIN IMPROVED WEARING QUALITIES

If you seek improved resistance of rubber and synthetic rubber parts to conditions causing excessive wear, ORCO may help you by developing an improved compound.

CONTROL VIBRATION

Elimination or reduction of vibration, shock, and noise in moving parts of machinery involve problems on which ORCO is prepared to co-operate on every phase of vibration isolation.

DETERMINE BEST SYNTHETIC RUBBER FOR SPECIFIC NEEDS

ORCO offers you an impartial source of information regarding the comparative advantages of all commercially available synthetic rubbers as applied to any stated specifications.

CONDUCT LABORATORY AND FIELD TESTS

ORCO research activities comprise modern laboratory equipment and an experienced technical staff available for complete co-operation "from test tube to field test."

SOLVE PROBLEMS OF BONDING RUBBER TO OTHER MATERIALS

Adhesion processes for bonding rubber and synthetic rubbers to metals and a wide variety of other materials are highly specialized services available to you at The Ohio Rubber Company (ORCO).

DESIGN EFFICIENT MOLDS AND DIES

When required, ORCO offers complete service in the engineering of molds and dies to meet your specifications for mechanical molded or extruded rubber and synthetic rubber parts.

ENGINEER SPECIAL TOOLS AND EQUIPMENT

If your requirements call for special tools and equipment for efficient, large-scale production, ORCO maintains a specialized engineering service.

REDUCES COSTS THRU IMPROVED METHODS

Unusual "flexibility" of ORCO production facilities assures improved methods to minimize costs on both small or large volume requirements on either intermittent or continuous runs.

IN ONE WORD, WE OFFER YOU

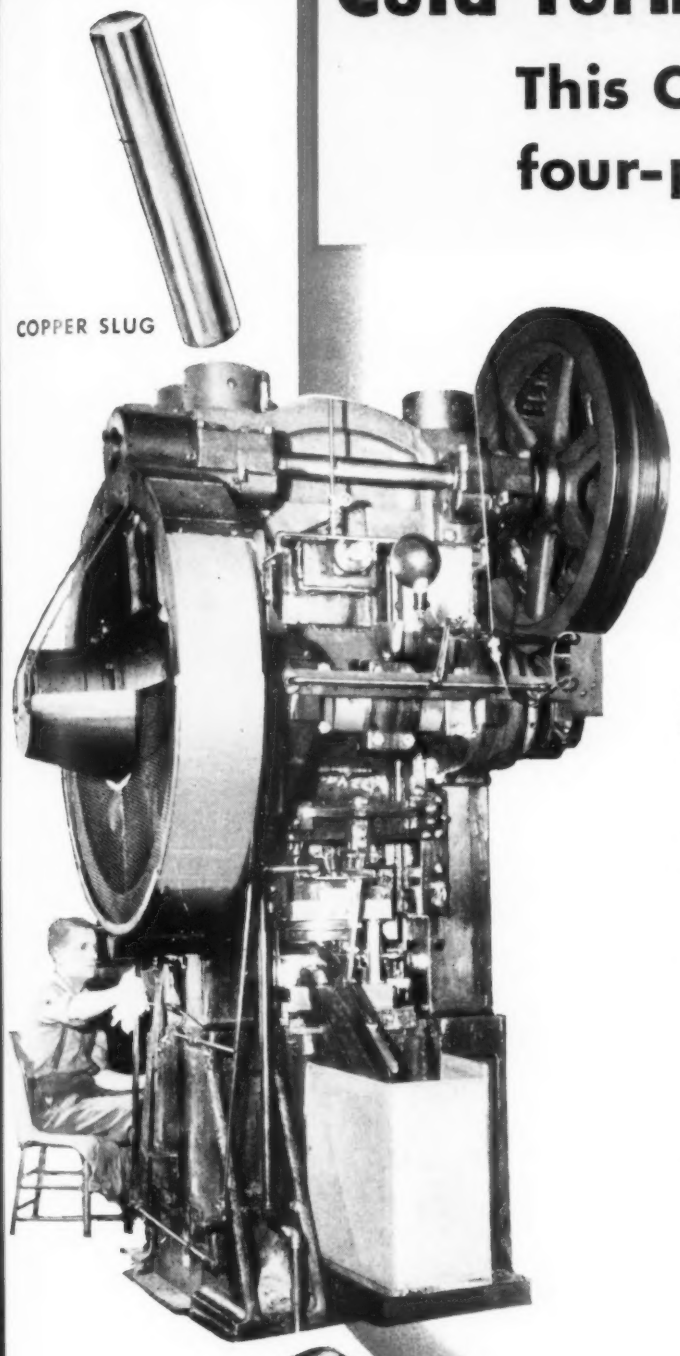
"ORCO-OPERATION"

THE OHIO RUBBER COMPANY · WILLOUGHBY, OHIO

BRANCHES: DETROIT · NEW YORK · CHICAGO · INDIANAPOLIS · WASHINGTON · CLEVELAND

Cold formed in one stroke

This Copper cap replaces four-piece Gillette assembly



Caps for Gillette Razors were formerly made in four pieces; the curved plate with a centered hole, a threaded center pin to which the handle was attached, and two studs for holding the blade in position. Furthermore, assembling the cap was a slow and tedious operation.

But things are different now—a faster, more accurate and economical method has been devised. Because of the excellent cold working properties of copper, thousands of caps are now produced daily . . . formed in one piece . . in 400-ton presses.

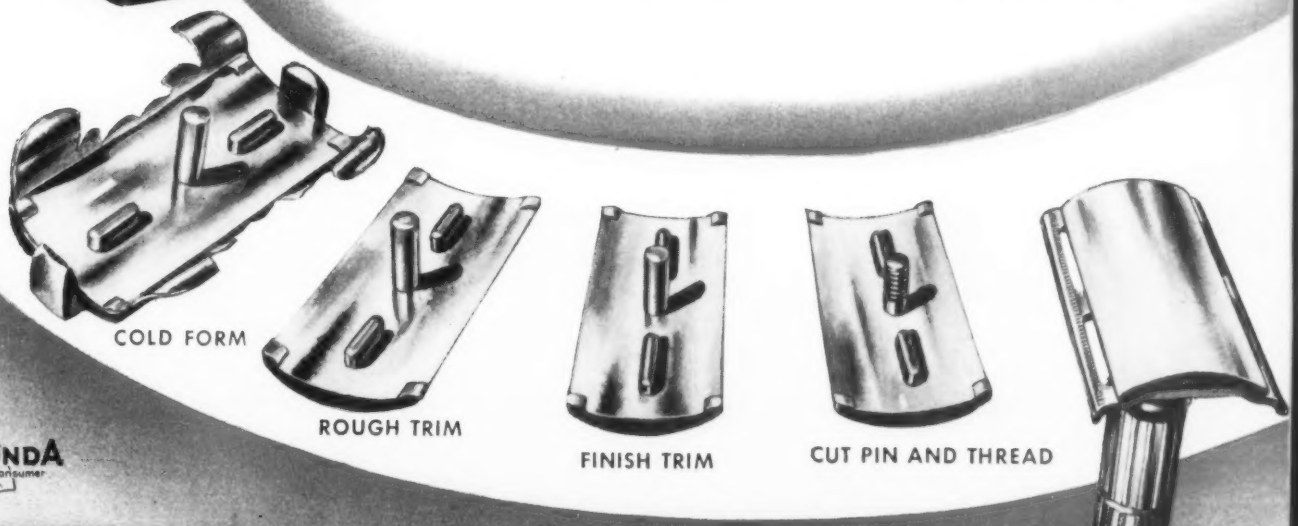
Coils of Anaconda Copper Rod .320″ diameter, are cut into slugs 1¾″ long and are magazine-fed into the press. The cold formed part, with flash attached, is illustrated below in actual size. The sequence of finishing operations is also shown.

RESULTS: *1.* Production has been speeded up about 200%. *2.* The one-piece construction eliminates the possibility of assembled parts working loose. *3.* Extremely accurate dimensions, necessary for blade alignment, are maintained without difficulty. And, as nothing serves like copper as a rust-free base metal for applied finishes, these Gillette Razor parts are readily plated with gold, nickel, chromium—or as desired.

Copper, or one of its many workable alloys, may be the answer to a similar job which you may consider especially difficult. Your inquiry will be given every consideration by our Technical Department.

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*



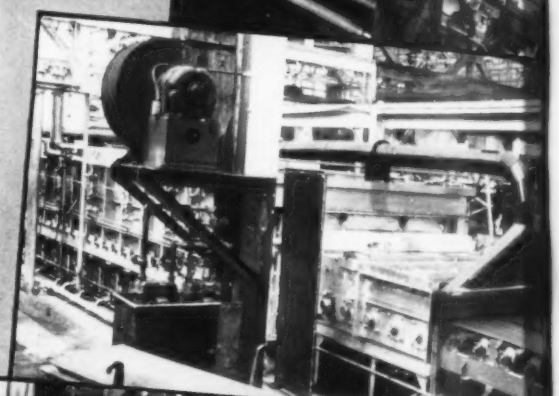
ANACONDA
from mine to consumer

Anaconda Copper & Copper Alloys

It takes more than Modern Equipment to meet ALL Sheet Metal Requirements

Cold rundown rolling of coils

Second-operation on four-high roll



Casting bars in water-cooled mold

Roller-hearth controlled mosphere annealing fur

Cold breako of cast ba

Production men know that low costs and smooth-flowing manufacturing operations go hand in hand when materials are consistently uniform—when sheet after sheet or coil after coil have the same fabricating characteristics.

But there's more to the making of such metal than modern equipment—important as that is. To produce brass plate, sheet or strip that meets ALL requirements calls for strict technical control over every step of production, from the casting shop to the last pass on the finishing rolls. For only in this way can the composition, grain size, temper and finish be controlled to obtain the best combination of properties for spinning, stamping, deep drawing or other fabricating operations.

In all probability, much time was devoted to the design and development of your sheet metal products—and also considerable money in tooling up for their production. So when you order copper, brass, bronze, or nickel silver, take the added precaution of specifying "ANACONDA". This is your assurance that the product is made by THE AMERICAN BRASS COMPANY to consistently uniform specifications and tolerances.

44210

THE AMERICAN BRASS COMPANY

ANACONDA
from mine to consumer

General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

Anaconda Plate, Sheet and Strip

Some **facts**

you should know about

Allymer

Columbia's new *thermosetting* *"contact-pressure"* allyl resin monomer

This significant contribution to the plastics field is of especial importance to manufacturers of products where Abrasion Resistance, Strength, Chemical Resistance and Ease of Application are essential. Allymer is now prepared in three basic types, all of which are suitable in varying degrees for either casting or impregnation:

Allymer CR 39—A monomeric liquid of low volatility which, when heated in the presence of a peroxide catalyst, readily solidifies to a hard, insoluble, infusible, glass-clear material. Especially suitable for castings, as it affords an unusually high degree of optical clarity.

Allymer CR 149—A crystalline monomer which gentle warming transforms to a liquid of low volatility. It assumes a structure similar to Allymer CR 39 when heated in the presence of a peroxide catalyst. When used with such laminates as paper, cloth, or Fiberglas, extraordinarily high strengths are obtained.

Allymer 170—A fast-curing liquid monomer, which may be modified in all proportions with Allymer CR 39 or CR 149 . . . the modification of properties being in the direction of those of the Allymer used.

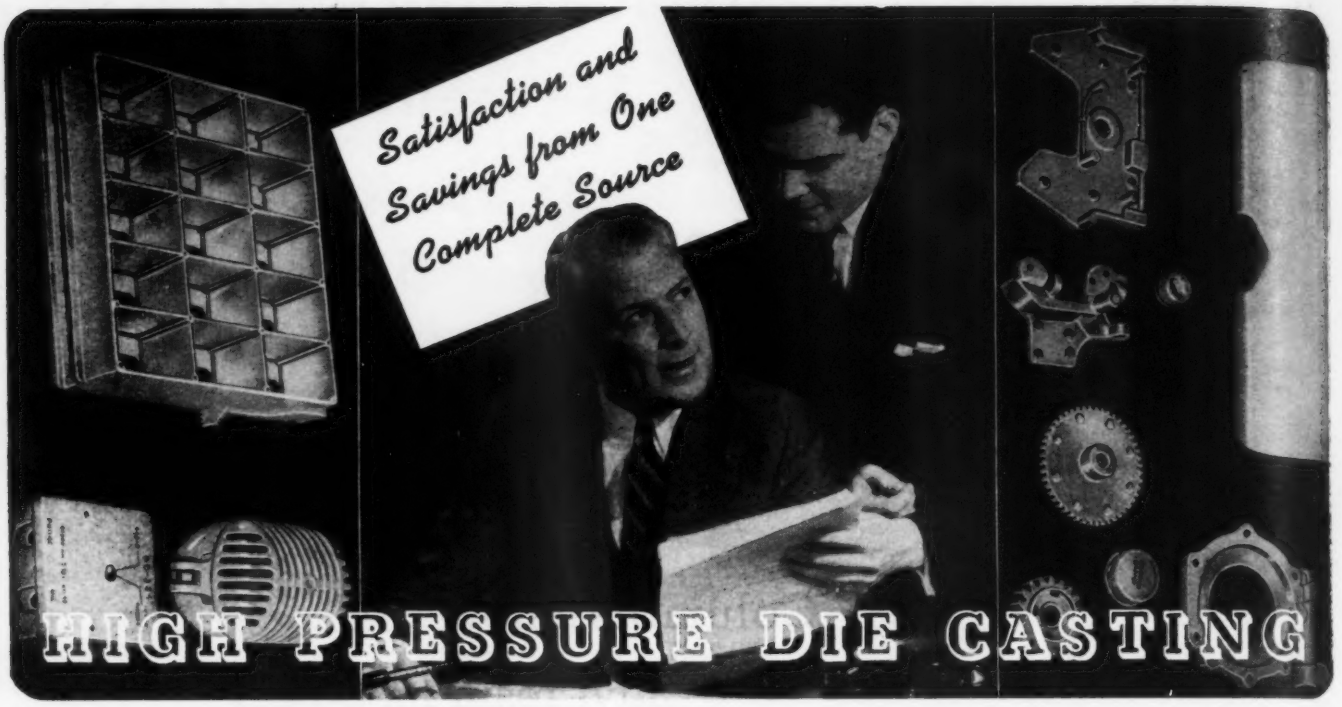
TECHNICAL INFORMATION AND SAMPLES AVAILABLE

If you are seeking a means of improving your products, or widening the scope of your operations, write for Data Sheets. Then, if the properties and characteristics of Allymer indicate potentialities for your business, samples may be obtained for experimental purposes.

COLUMBIA CHEMICALS

PITTSBURGH PLATE GLASS COMPANY
COLUMBIA CHEMICAL DIVISION
GRANT BUILDING • PITTSBURGH 19, PA.

CHICAGO • BOSTON • ST. LOUIS • PITTSBURGH • NEW YORK • CINCINNATI • CLEVELAND • PHILADELPHIA • MINNEAPOLIS • CHARLOTTE



From Start to Finish

the materials cast into your products are subject to complete control over both chemical and physical properties. Uniformity and inner-quality are assured through our Spectographic, Radiographic and physical testing equipment. Precise and efficient methods that served the Automotive, Aviation and Home Appliance Industries in Peace-time play a valuable part in wartime manufacture. Remember—our specialty is high-pressure die castings in the metal or metals which your products require.

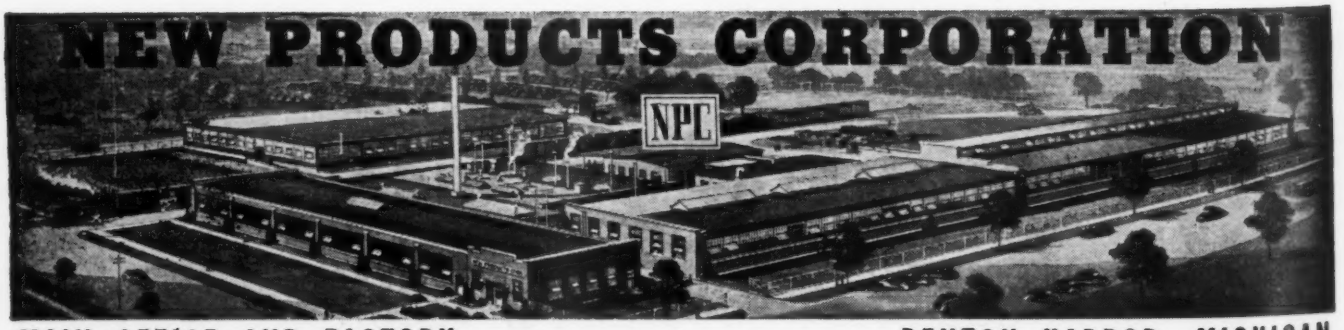
★

ALUMINUM
★
MAGNESIUM
★
ZINC

Plan now for those highly competitive peace days, when consumer again has A-1 priority. Ask New Products to work out your problems—complete, if you wish, from blueprint to finished product—in

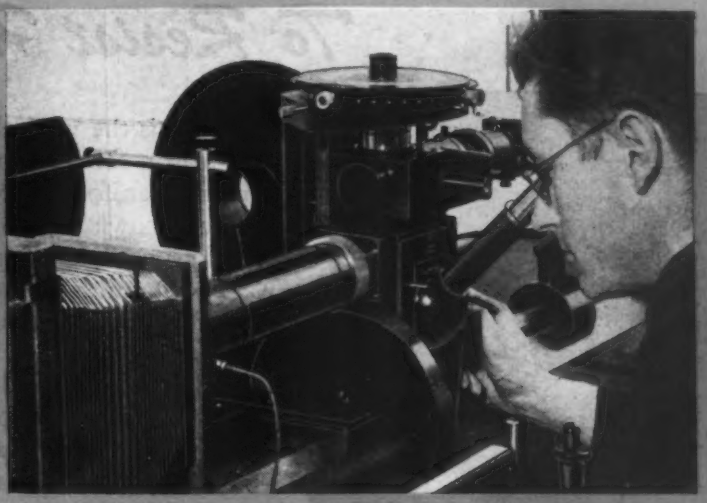
HIGH PRESSURE DIE CASTINGS

★



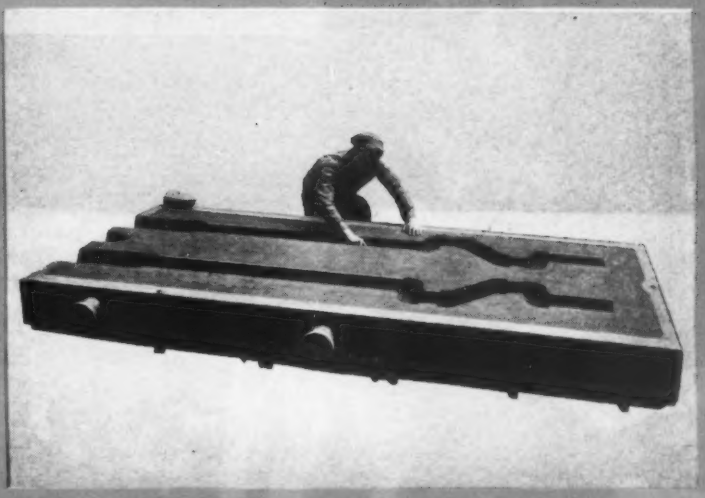
MEEHANITE CASTINGS

FORESIGHT IN ENGINEERING AND RESEARCH



Study of photo-micrographs assists in the control of the metallurgical structure of metal—an important factor in achieving uniform dependability.

ADVANCED FOUNDRY PRACTICE



In the production of Meehanite Castings all branches of foundry practice are regulated and consist of modern, scientific methods.

METALLURGICAL PROGRESS

Progress is achieved through continual study of metallurgical factors.

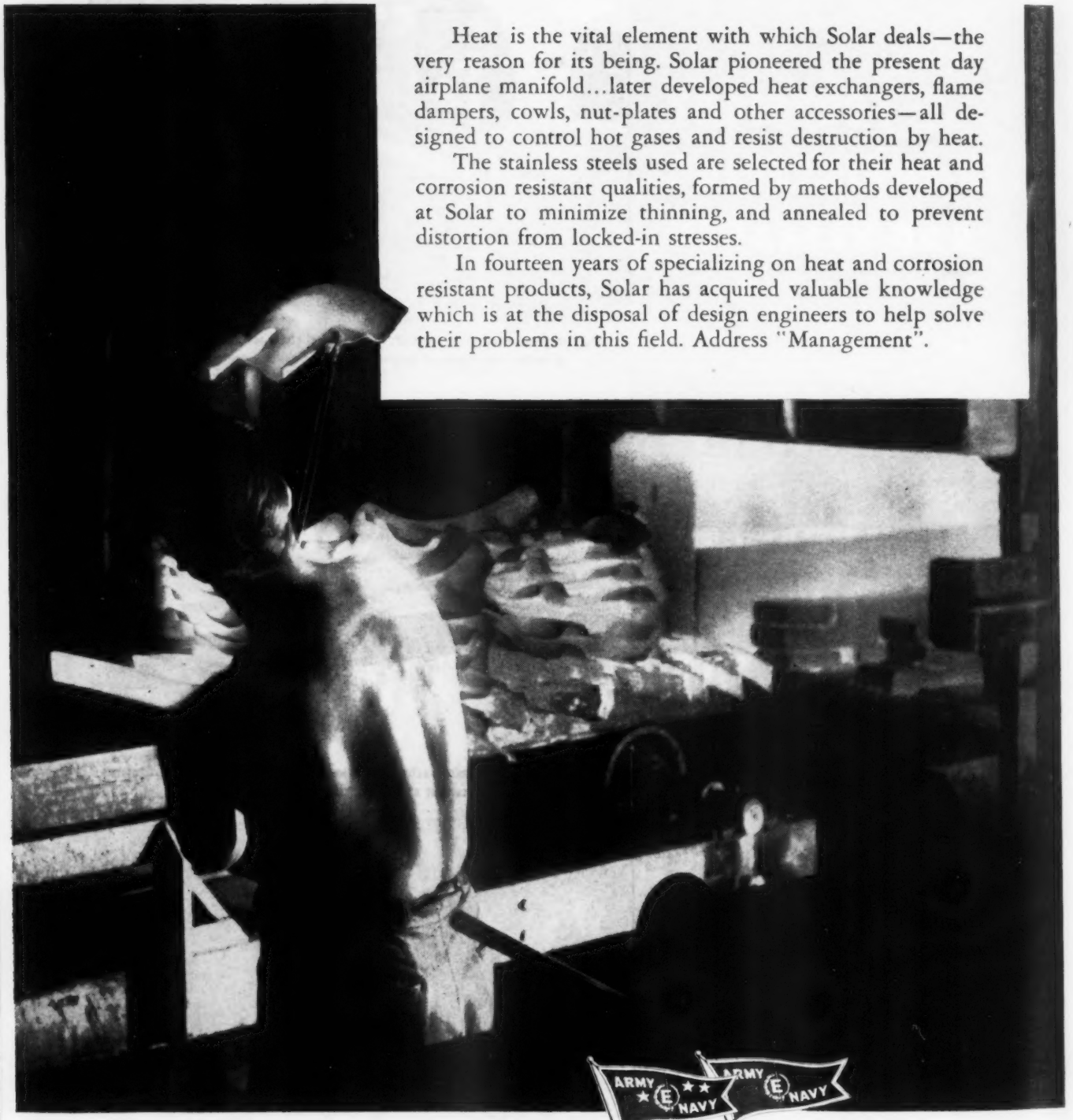
MEEHANITE RESEARCH INSTITUTE

PERSHING SQ. BLDG. NEW ROCHELLE, N. Y.

MEEHANITE QUALITY CONTROL ASSURES UNIFORM DEPENDABILITY

Turning on the Heat...

To Resist Heat Destruction!



Heat is the vital element with which Solar deals—the very reason for its being. Solar pioneered the present day airplane manifold...later developed heat exchangers, flame dampers, cowls, nut-plates and other accessories—all designed to control hot gases and resist destruction by heat.

The stainless steels used are selected for their heat and corrosion resistant qualities, formed by methods developed at Solar to minimize thinning, and annealed to prevent distortion from locked-in stresses.

In fourteen years of specializing on heat and corrosion resistant products, Solar has acquired valuable knowledge which is at the disposal of design engineers to help solve their problems in this field. Address "Management".

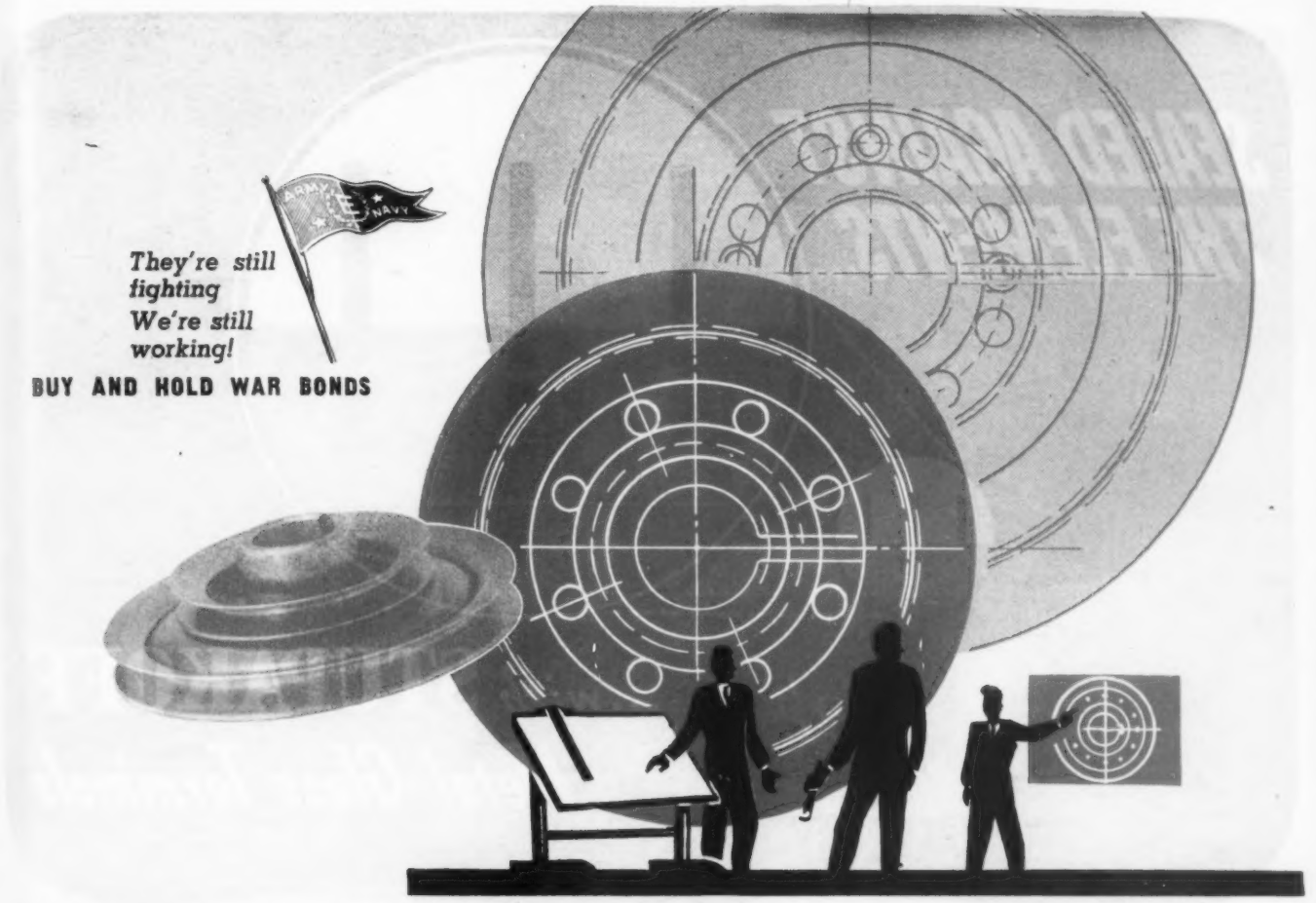
ARMY ★ E ★★ NAVY ARMY E NAVY

SOLAR

STAINLESS STEEL PRODUCTS

SOLAR

SOLAR AIRCRAFT COMPANY SAN DIEGO 12, CALIF. DES MOINES 5, IA.



They're still fighting
We're still working!

BUY AND HOLD WAR BONDS

OUR ENGINEERS TALK in CIRCLES ... and it MAKES SENSE!

In discussing custom design of Spunsteel roller-formed pulleys you have to talk in circles—O.D.'s, I.D.'s, P.D.'s, and R.P.M.'s. And regardless of how complex each individual problem of application may be, its ultimate solution must make sense. The V-type pulleys you will need, for instance, may require but a single belt groove or they may require two, three or even four grooves—with all diameters identical or each diameter different. No matter what your pulley problem is, Spunsteel engineers would welcome the opportunity to assist in its solution. Eighteen years of specialized experience is your assurance that Spunsteel pulleys will be properly designed and properly fabricated to fully meet your specific needs and to provide for utmost economy in mass production. The patented Spunsteel automatic roller-forming lathes consistently turn out perfectly balanced, light weight, steel-strong pulleys for drive and driven installations. Consult Spunsteel on your pulley problems, and remember too, our extensive facilities for stamping, brazing, welding, assembling and finishing of other metal parts. Spunsteel Metal Engineering has a way with steel, doing things you might never have dreamed possible!

NOW MAILING

Six pages of pictures and facts on Spun Steel Metal Engineering will help you in organizing postwar production. This dependable source for metal parts offers the full co-operation of its creative engineering personnel for discussion of your problems now. Especially interesting: redesign of forged and machined bar stock parts for precision fabrication from stampings. Write today.

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SEALED AGAINST THE ELEMENTS...

...with STUPAKOFF Metal-Glass Terminals

The hermetically sealed transformer illustrated functions properly under the most adverse conditions. Stupakoff metal-glass terminals, soldered, welded or brazed to the container, protect against humidity, fungi and other elemental hazards. Ideal working conditions are sealed in—detrimental conditions are sealed out.

Stupakoff metal-to-glass sealed terminals are made possible by the metal, Kovar—a cobalt, nickel iron alloy which forms a chemical bond with glass through a heating process, in which the oxide of Kovar is dissolved into the glass. Kovar matches the expansion of thermal shock resistant glass and forms a permanently vacuum and pressure tight seal.

Stupakoff manufactures Kovar-glass terminals with single or multiple, solid or hollow electrodes. For those equipped to do their own glass working, Kovar is supplied as sheet, rod, wire, or tubing; or fabricated into cups, eyelets or special shapes.

Write Stupakoff today for assistance in engineering Kovar-glass terminals to your product.

KOVAR*-Glass Seals for

ELECTRONIC TUBES
TRANSFORMERS
RESISTORS
CAPACITORS
CONDENSERS
VIBRATORS
SWITCHES
RELAYS
INSTRUMENTS
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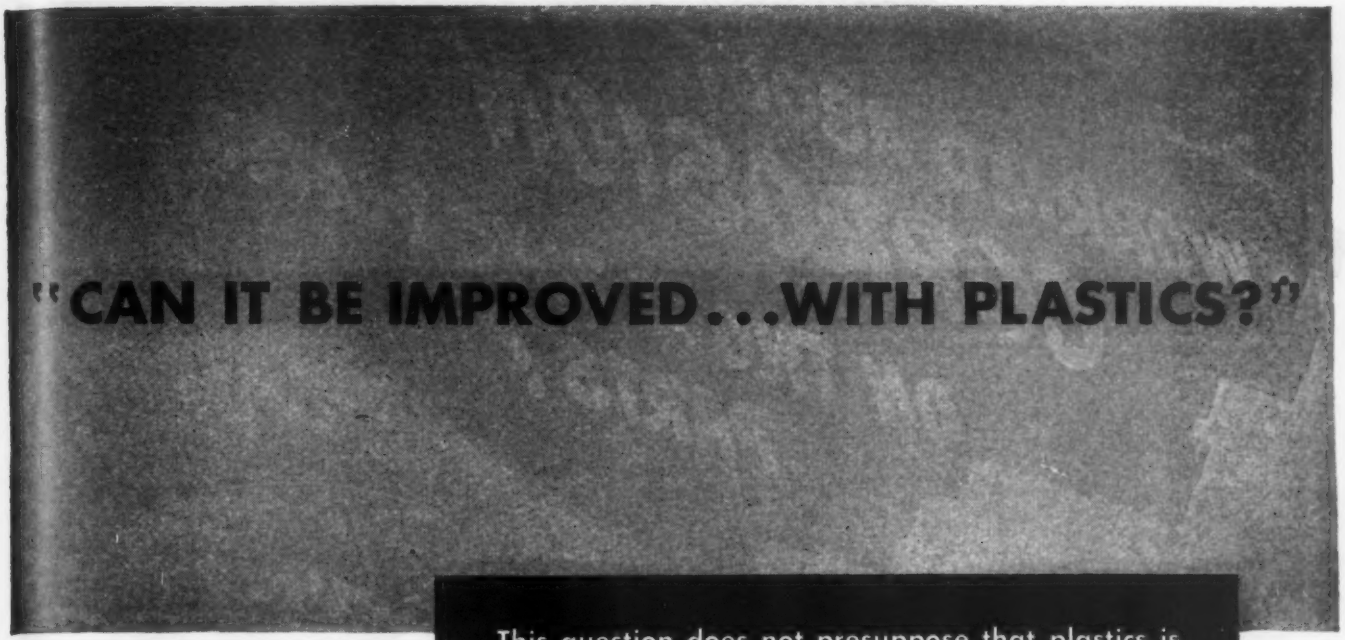
DO MORE THAN BEFORE—BUY EXTRA WAR BONDS

*TRADE MARK 337962 REGISTERED IN U. S. PATENT OFFICE

ARMY E NAVY "FOR GREAT ACHIEVEMENT"

STUPAKOFF CERAMIC AND MANUFACTURING CO., LATROBE, PA.

Products for the World of Electronics



This question does not presuppose that plastics is the magic "cure-all." On the contrary it rules out the lady-luck influence as irrelevant to the problem.

"Can it be improved with Plastics?" is the number one question in any consideration of engineered plastics for a product or part.

Our engineers are trained to consider plastics in relation to the requirements of a product and the improvement desired. They have an appreciation of the complementary values of plastics and metals and have developed some original techniques with these combinations which have solved a number of product problems.

Improvements in products and parts have been attained by us through close collaboration with the design and production staffs of aircraft manufacturers. Along similar lines, we may be able to suggest applications of molded plastics to your products . . . present or planned.

For the right application of plastics to your product, call on Plastic Manufacturers during the design stage. The design of your product may determine how close tolerances can be held. Selection of the right plastic material and molding method should be left to our experienced judgment. Send for free copy of Folder File PB1, describing our facilities.

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AND MOLDING SKILL

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PLASTIC MANUFACTURERS

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ENGINEERED PLASTICS FOR INDUSTRIAL APPLICATIONS

MOLD MAKING • INJECTION & TRANSFER MOLDING • COMPLETE ASSEMBLY

WORRIED ABOUT CORROSION ON THOSE ZINC PLATED PARTS?

INVESTIGATE ANOZINC*

Simple anodic treatment gives zinc surfaces greater protection against corrosion and outdoor exposure.

If your zinc plated parts need extra armor against rust, provide it economically with ANOZINC — the bath that steps up service life of zinc plating — makes it more resistant to corrosion and handling. For example — Parts finished in the Anozinc solution have stood up under the Army-Navy salt spray test AN-QQ-S-91 for over 200 hours.

Here are the highlights of what the ANOZINC bath offers:

AN INEXPENSIVE METHOD of producing by anodic treatment a durable finish on zinc plate. The moderate-priced salts, short operating cycle and standard drying procedures combine to keep the cost low.

SIMPLE EQUIPMENT. Your ordinary plating facilities in most cases can be readily converted to use this bath. ANOZINC salts are convenient to handle, ship and store.

EASILY CONTROLLED SOLUTION. It's readily maintained and doesn't require frequent additions. The bath, operating at room temperature, needs no heating or refrigeration . . . produces a temperature-stable surface which is an excellent base for baking or air-drying paints and lacquers.

TWO ATTRACTIVE FINISHES can be obtained — a deep, semi-lustrous black, and a brassy, slightly iridescent yellow — a different bath being used for each finish. Slight variations are also possible within the two color ranges.

FURTHER INFORMATION will be sent promptly — write to the nearest office below. Mention the kind, quantity and size of parts to be treated. Your inquiry will receive immediate attention.

OTHER U. C. PRODUCTS AND PROCESSES TO SERVE YOU

CHROMIUM PLATING for wear-resisting, oil-retaining and other types of finishes.

☆**UNICHROME ALKALINE COPPER** for smooth, lustrous copper plating in a non-cyanide bath.

☆**UNICHROME STRIP** for speedy removal of copper, chromium, zinc, etc., from steel and cast iron without etching the base.

☆**UNICHROME RACK COATINGS** specially formulated to stand up under the most severe operating cycles.

☆**UNICHROME STOP-OFF LACQUERS AND COMPOUNDS** specially formulated to meet specific plating problems.

☆**UNICHROME CLEAR LACQUERS** specially formulated to meet specific finishing requirements.

☆**UCILON** — a corrosion-resistant coating for protecting surfaces against acids, alkalies, water, gasoline and various corrosive chemicals.

☆Reg. U. S. Pat. Off.

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Tune in "Everything for the Boys"
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THAT'S what it amounts to when our B-29 fortresses pay Hirohito a visit. For in these mighty ships are vital die cast parts made by Auto-Lite in their Die Casting Plant at Woodstock, Illinois.

There are complete facilities, at Woodstock, for zinc and aluminum die casting, production and precision machining, a wide variety of finishes and a completely modern testing laboratory. Such integration of manufacture simplifies your job of production, makes more certain the meeting of your requirements in precise detail.

For information about how our facilities can help solve your problem, write

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CHICAGO 5, ILLINOIS

723 New Center Bldg.
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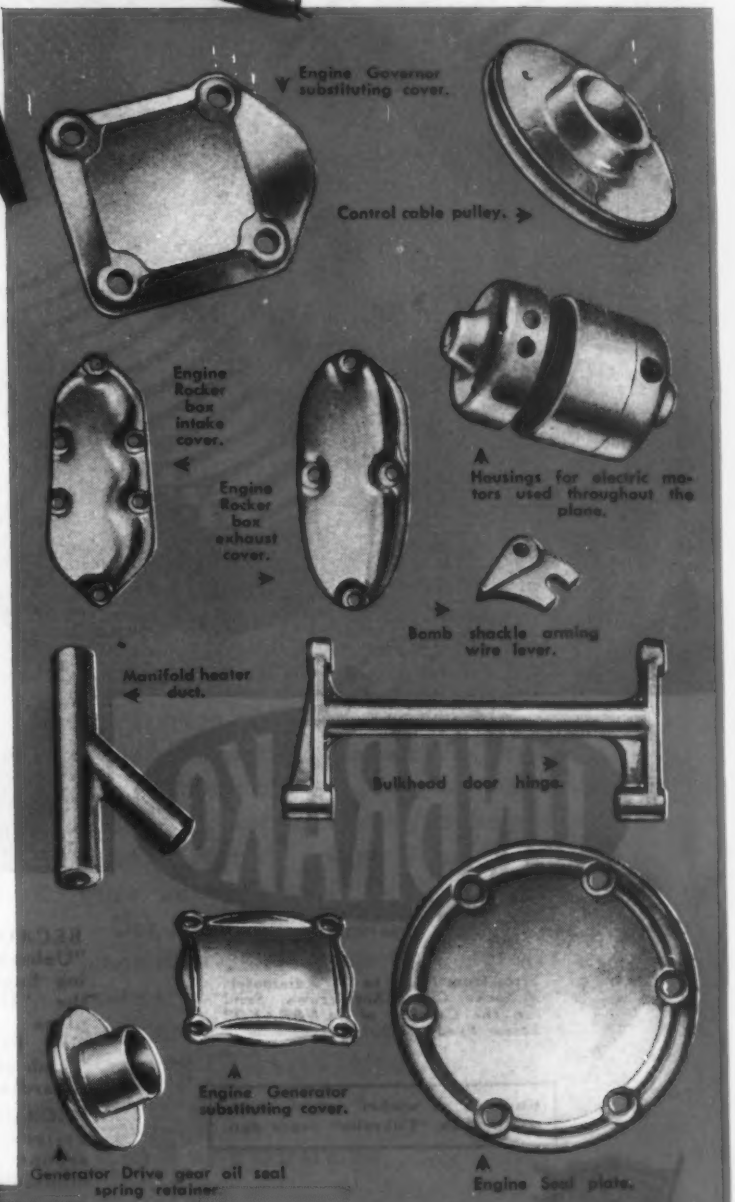
Engine Governor substituting cover.
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Engine Seal plate.

AUTO-LITE Die Casting

If you specify "UNBRAKO" SOCKET SCREWS, *you can't go wrong!*

UNBRAKO

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Sizes from No. 4 to 1½" diameter, in Socket Cap & Set Screws. *Send for the Catalog of "UNBRAKO" Screw Products.*

Knurling of socket screws originated with "Unbrako" years ago.

ARMY E NAVY

BECAUSE they're knurled. The *knurled* head of the "Unbrako" Socket Cap Screw speeds production by preventing finger-slip and lost motion. The *knurled* cup point of the "Unbrako" Hollow Set Screw locks the screw in place . . . defies vibration. And for use where the Knurled Cup Point is unsuitable—there is our *Knurled* Thread "Unbrako" Socket Set Screw. This too is a Self-Locker, regardless of the style of point.

BECAUSE being Socket Screws they permit more compact designs by virtue of this hex wrench fitting within, not around the head whereby the "Unbrako" needs but a minimum of clearance.

BECAUSE of their great tensile strength, which permits the use of smaller and fewer screws.

OVER 40 YEARS IN BUSINESS

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA, BOX 102 • BRANCHES: BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO

A die-cast part like this

adds lightness to lightness

Thin walls, possible in Mazlo Magnesium die castings, permit weight saving on a mass production basis unequaled by any other process. Because the molten metal is forced into dies under high pressure, wall thicknesses can be much thinner than those cast in sand or permanent molds.

Note the fineness of detail in that Mazlo Magnesium die casting. With but little machining, it is ready for the assembly line. And even that work goes fast, for magnesium machines smoothly and accurately at high speeds. The combination of thin sections, low fabricating and machining costs frequently places magnesium die castings on a competitive basis with the heavier metals.

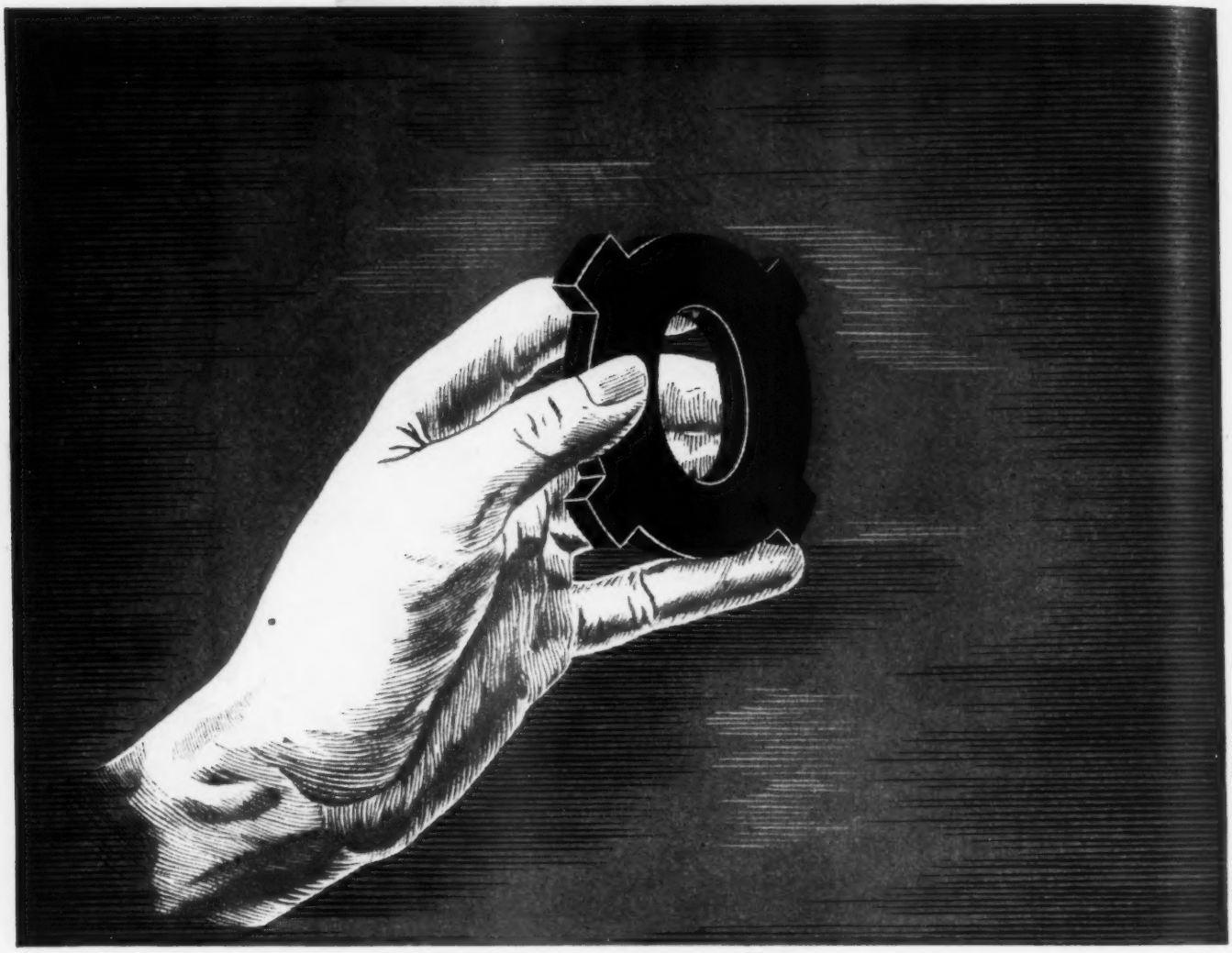
Among the magnesium products going into our fighting planes are many die castings made by American Magnesium Corporation. Their extreme lightness, compactness and dependability are contributing to the advancement of aircraft design. They will do the same for you.

Our engineers will assist you in adapting magnesium die castings to your wartime or postwar products. Aluminum Company of America, Sales Agent for Mazlo Magnesium Products, 1702 Gulf Bldg., Pittsburgh 19, Pa.

MAGNESIUM MAZLO PRODUCTS

AMERICAN MAGNESIUM CORPORATION

SUBSIDIARY OF ALUMINUM COMPANY OF AMERICA



what is GRAPHITAR ?

(CARBON-GRAPHITE)

Graphitar, a product of The United States Graphite Company, is a carbon-bonded carbon and graphite material having a chemical analysis of over 97% pure carbon. Because of its varied unusual properties, Graphitar is the ideal material for many applications.

WHAT ARE THE PROPERTIES OF GRAPHITAR?

Graphitar is non-metallic yet mechanically strong, with a high transverse breaking strength. Graphitar is extremely light—its weight is less than magnesium. Graphitar is sufficiently self-lubricating for most uses—and any liquid will serve as a lubricant where further reduction of friction is required. Thus Graphitar parts are especially practical for inaccessible moving parts. Graphitar is chemically inert. It is not affected by heat, acids, gasoline or water. It will not shrink, expand, warp, melt, vaporize, corrode or scale. In almost any shape, Graphitar can be machined to very close tolerances.

HOW IS GRAPHITAR USED?

In literally hundreds of ways Graphitar has proven its utility. It makes drop-tight mechanical seals in pumps. Graphitar automobile clutch release bearings are far superior to those made of other materials. In non-lubricated compressors handling gases such as steam, air, carbon dioxide, freon, and hydrogen sulphite, Graphitar piston rings are very efficient.

Graphitar has proven successful for steam turbine sealing rings, pump blades, fluid coupling sealing rings, conveyor bearings, cylinder liners, water meter discs and in many other applications —the list is long and rapidly getting longer.

Graphitar may solve an engineering or mechanical problem troubling you. Write today for 24 page illustrated book of facts.

THE UNITED STATES GRAPHITE COMPANY • SAGINAW, MICHIGAN

DOUGLAS AIRCRAFT *Steps Ahead*

WITH FIBERGLAS*-REINFORCED PLASTICS

In jigs, dies and fixtures, plastics are modifying long-established patterns of thinking and ways of doing things.

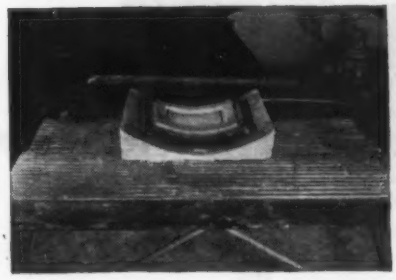
Douglas Aircraft Engineers, working with the fast-developing techniques of low-pressure laminating, the remarkable new contact pressure resins and with Fiberglas Cloth reinforcement, have taken a revolutionary step from metals to plastics.

The jig shown here, with progress pictures of its manufacture, was fabricated from Fiberglas-reinforced laminated material. Result—the high cost of manufacturing metal tools was reduced. Costly, time-consuming machining was avoided.

The advantages which Fiberglas-reinforced laminates bring to an operation of this kind are lightness, rigidity, dimensional stability, high impact strength and ease of fabrication. And these desirable qualities can be traced back to some of the inherent properties of Fiberglas . . . glass in fiber form.

The Fiberglas fibers have a specific tensile strength beyond that of steel. Because they are inorganic and noncellular, they will not absorb moisture, will not shrink, swell, rot or decay. Therefore, they make ideal textile fibers for specific purposes. Twisted into yarns, woven into cloth and put into plastic laminates as structural reinforcement, they produce finished materials with the advantages which Douglas and a host of other fabricators are so skillfully utilizing.

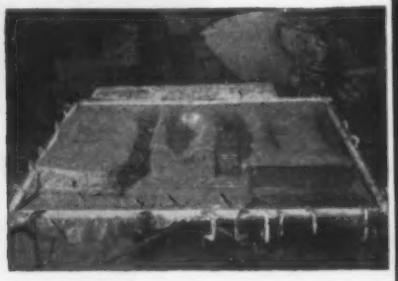
Fiberglas Corporation does not manufacture resins or finished laminates. However, if you are working with or contemplating using plastics laminates you will want complete information on Fiberglas Cloth. It is yours for the asking. Write *Owens-Corning Fiberglas Corporation, 1878 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*



The male mold is placed on a corrugated metal table with an air valve for producing vacuum.

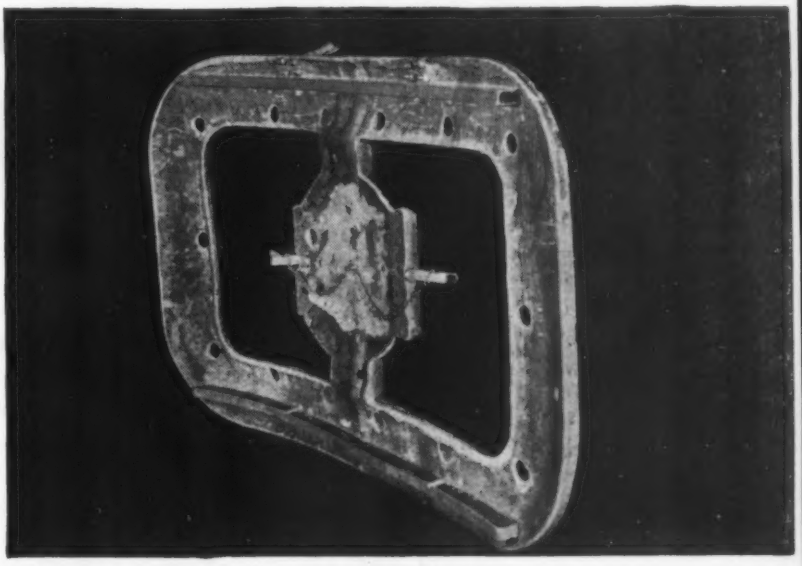
The desired number of layers of resin-saturated Fiberglas Cloth are applied to the mold one after another.

A rubber blanket is stretched over the mold and hermetically-sealed at the edges to form a vacuum bag.



Air is evacuated. The table is then rolled into the oven to complete the polymerization of the resin.

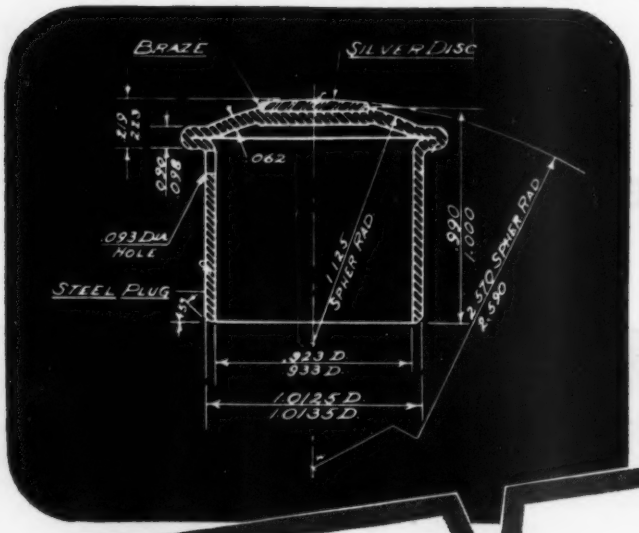
Photos courtesy: Douglas Aircraft Co., Inc.



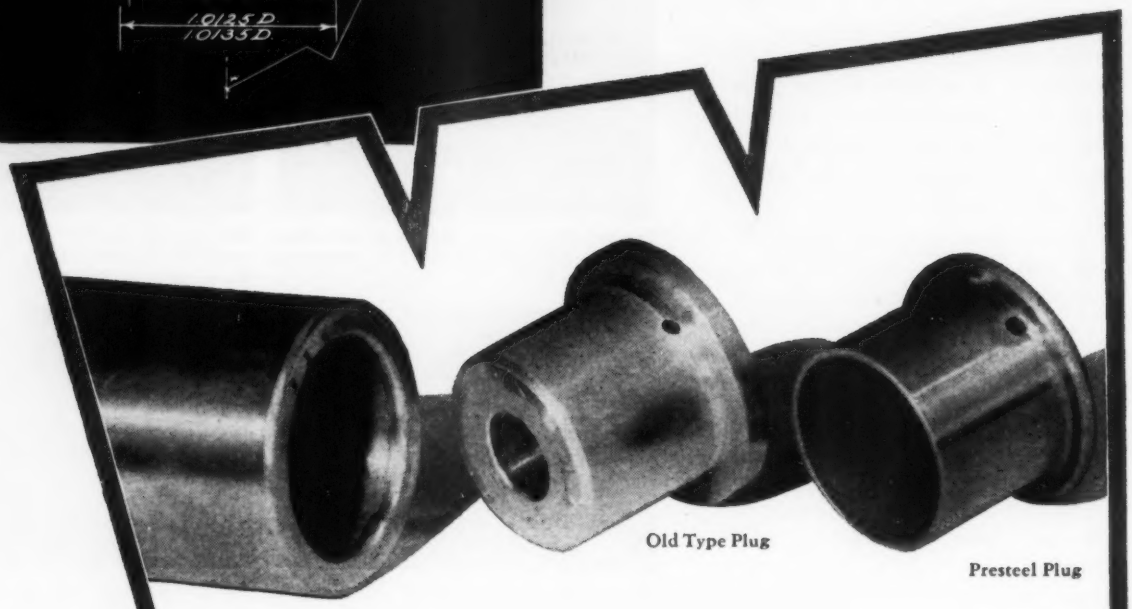
The completed jig.

FIBERGLAS..A BASIC MATERIAL

*T. M. Reg. U. S. Pat. Off.



Detail Drawing of the Steel and Silver Plug



Old Type Plug

Presteel Plug

A Unique Silver and Steel Stamping Assembly

An outstanding Presteel achievement has been the development of drawn steel piston pin plugs to replace plugs machined from solid aluminum rod. These plugs are used in the ends of the piston pins of aircraft engines. As there are two plugs in each cylinder and replacements are fairly frequent, a considerable tonnage of critical aluminum was saved. The old type plug, shown on the left above, weighed 1.28 oz. as compared with .91 oz. for the drawn plug, shown on the right, yet the new plugs have superior wearing qualities. Thin silver discs are induction brazed to the heads of plugs. For further details of this unique assembly, write to:

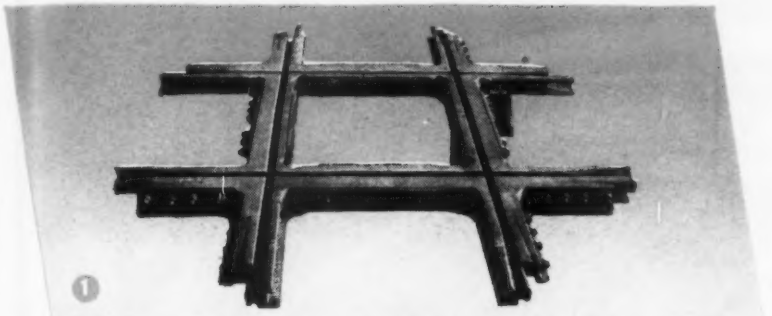
WORCESTER PRESSED STEEL CO.

701 Barber Avenue, Worcester 6, Mass.

ALLOY STEELS AND OTHER METALS COLD FASHIONED SINCE 1883

TISCO MANGANESE STEEL

Hardens itself to the needs of the job!



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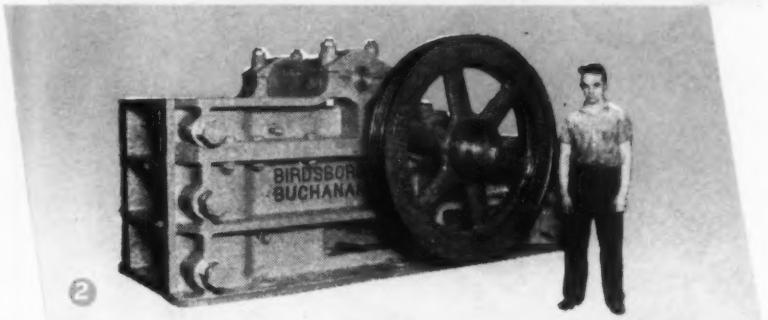

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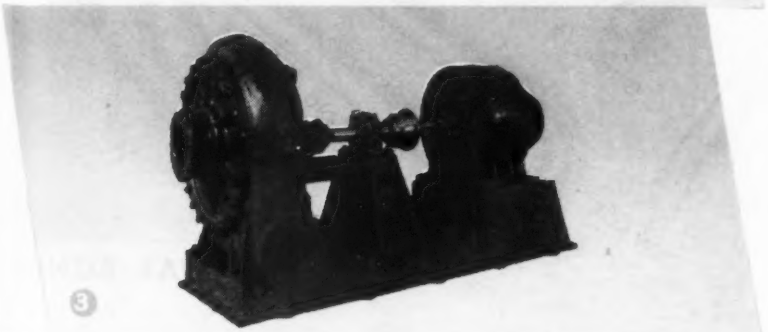

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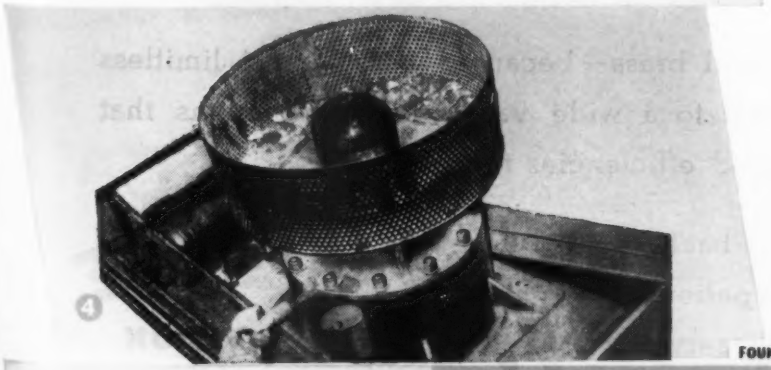

4

5

The HARDER it works the TOUGHER it gets!

On heavy jobs where a combination of heavy impact and abrasion is encountered, there is no metal that will stand up like TISCO Manganese Steel. This steel has the unique property of cold work-hardening. When cast and heat-treated, TISCO Manganese Steel runs about 190-200 Brinell. However, under heavy impact and abrasion, it rapidly work hardens, forming a surface 1/16" to 1/8" thick of dense, hard steel as high as 450 Brinell. The softer, tougher body underneath absorbs shocks and prevents breakage.

If your product requires utmost resistance to impact and abrasion, specify TISCO Manganese Steel . . . the original Hadfield's Manganese Steel. We are equipped to cast from ½ ounce to 20,000 pounds. Consult with our engineers on the application of TISCO Manganese Steel to your product. Write for literature giving physical properties.

1. Wharton "Scientific Design" Solid Manganese Steel Railroad Crossing Trackwork.
2. TISCO Manganese Steel wearing parts are used in this Birdsboro-Buchanan Crusher.
3. TISCO Manganese Steel selected for wearing parts of Morris Dredge Pumps.
4. TISCO Manganese Steel Screen Plates shown on Allis-Chalmers Reduction Crusher.
5. TISCO Manganese Steel gives utmost service on Jaw Crusher Parts.

FOUNDED TW 1742

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SPECIAL TRACKWORK • MISC. SEAMLESS TUBING

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BUY WAR BONDS

Seamless tubing—both copper and brass—because of its almost limitless forming possibilities—lends itself to a wide variety of applications that result in economies and increased efficiencies to users.

Here at Wolverine is equipment—backed up by many years' specialized experience in the fabrication of tubing—at your service to furnish the completed parts to your specifications or to give you the help that will enable you to make them yourself. There's no obligation in consulting with us.

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Rolling the Impossible

ON A SPLIT-SECOND SCHEDULE

"Tough jobs," said the Colonel, "are expected, but this one is virtually impossible. It means rolling to practically a *zero* tolerance . . . Other mills say, *it just can't be done.*"

How Weirton meets such requirements is a story of unbelievable precision—an amazing report of perfect integration between advanced industrial thinking and remarkable facilities —the same "know how" that *overnight* made Weirton the sixth largest U. S. producer of rolled brass—the *only* mill ever able to adapt ponderous steel equipment to this delicate operation.

Again, it was Weirton that solved the problem of rolling magnesium in extremely thin gauges. They went to Weirton too, when an important war application required the rolling of silver chloride into plastic-like slabs . . . All in all, Weirton has developed and manufactured ten entirely new, vital products since Pearl Harbor.

These examples of difficult rolling are introduced merely to show the extreme accuracy possible with Weirton's equipment and to illustrate the experience and ingenuity of Weirton's people . . . a winning combination that has already translated itself into remarkable improvements in hundreds of home-front products.

WEIRTON STEEL CO.

WEIRTON, WEST VIRGINIA · *Sales Offices in Principal Cities* · *Division of* **NATIONAL STEEL CORPORATION** *Executive Offices, Pittsburgh,*

PLASKON *is on Active Service Duty Everywhere*

THE GREAT RANGE of features offered by Plaskon has stimulated s application to many difficult and nusual jobs.

ypical among these is the Plaskon folded Color adapter cone used on ie United States Army Field Unit r dental X-ray purposes in base spitals. Here Plaskon supplies the *iform density* that is an absolute quirement of the cone. Any varia- n in density, or the use of metal, ass or other substances of high mic density, would cause objection- able images on the film. And Plaskon does not break down under the terrific impact of X-rays which can disturb the molecular structure of many materials.

Because the cone is used in close proximity to the face, Plaskon supplies the obvious needs for a smooth, high-lustre finish that will remain clean, bright and sanitary. High dielectric strength, resistance to shock, retention of dimensions over a wide temperature range, and moldability to high precision standards, are other advantages which determined the selection of Plaskon for this important use.

Plaskon can be supplied in a complete range of colors, and can be molded into shapes and sizes serving many practical needs at attractively low costs. Our experienced technical men will give you valuable assistance in adapting Plaskon materials to present needs and peacetime planning.

ASKON DIVISION, Libbey • Owens • Ford Glass Co. • 2126 Sylvan Ave., Toledo 6, O.

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PLASKON

TRADE MARK REGISTERED

MOLDED COLOR

PLASTIC-BASE

Paladin

TAMES UNRULY ZINC

UNAFFECTED BY 5 YEARS AGING

UNIQUE ADHESION

ZINC, plated or die cast, defies conventional finishes. Roxalin's Paladin is helping overcome this difficulty.

For example, back in 1939, a producer of auto radio grilles made of die cast zinc had a 4-way finishing problem. He needed a coating that: 1. would cling to untreated zinc without chipping or peeling; 2. would bond or anchor a decorative top coat in certain areas; 3. would provide a colorless film of protection for the polished highlights of the grille; 4. and would not require baking at temperatures that would distort the die castings.

The splendid adhesion of clear Paladin led to its use for this job. After 5 years this plastic-base finish is as tough, adherent and as brightly polished as the day it was applied.

NOW—*a guide to Product Finishing*

You will want to read the comprehensive report on the results of Roxalin's "Twenty Years of Plastic Surfacing." Documented case histories from our files plus exact specifications make it a must for your technical library. Here is a book that will give you ideas of how the right type of plastic-base finish can speed production, lower costs and help you design a better product. Write to Dept. 806 immediately on your letterhead as only a limited number of copies are available.

ROXALIN *Flexible* FINISHES

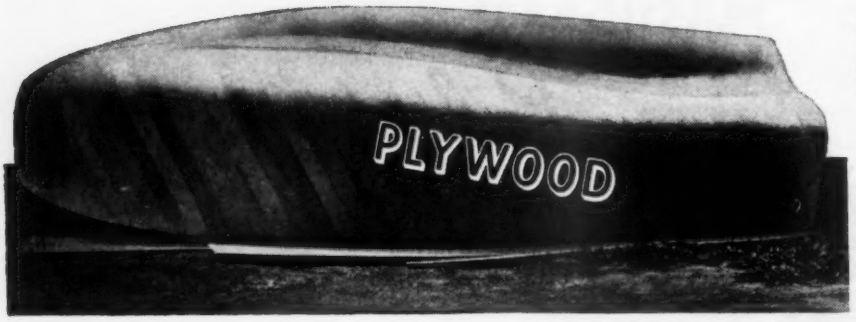
INCORPORATED

ELIZABETH, N. J. • NEW JERSEY

PIONEERS IN PRODUCT FINISHES ENGINEERED FOR SPECIFIC PERFORMANCE

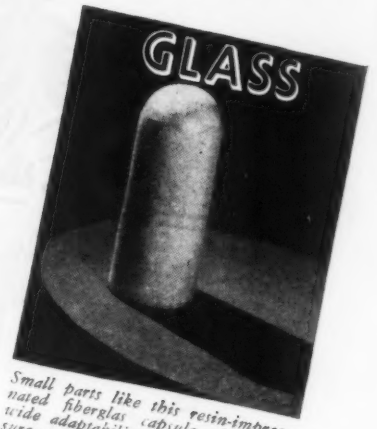
Molding

MAY BE THE ANSWER TO YOUR PROBLEM



This 18-foot hull for Army Utility Power Boats is molded in one piece of veneers and phenolic resin. Weight 245 lbs.

OUR VARIED EXPERIENCE AND EXTENSIVE FACILITIES FOR THE MOLDING OF PLYWOOD AND OTHER MATERIALS ARE AT YOUR DISPOSAL



Small parts like this resin-impregnated fiberglas capsule show the wide adaptability of the low pressure molding technique.

High grade duck, resin-impregnated, molded at low pressure in lengths up to 20' for the U. S. Armed Forces.

Light weight, high strength corrugated panel sections of paper and phenol offer interesting postwar possibilities.

Low pressure plastic molding may well provide many of the answers to Industry's post-war design and production problems.

Wartime applications of the low pressure molding technique will provide a field-laboratory evaluation of the several types of resins and reinforcing materials now known to give practical results.

Of the resins, the polyesters, phenolics, vinyls and melamines currently offer the most promise, since they are now being successfully combined with a number of reinforcing materials.

United States Plywood Corporation is producing low pressure molded parts which utilize all types of resins in a variety of combinations.

Phenolic resin and veneers produce the famous Army Engineer Corps' Utility Power Boat hull.

High strength Mitscherlich paper and phenolics produce flat, corrugated, and compound curved parts.

Fiberglas and duck are being used to reinforce both the polyester and phenolic resins in the forming of critical radar parts.

Low pressure molding technique is a comparatively new development, and has not yet proved adaptable in every instance. The method is especially suited to the forming of large units, or those required in a relatively small volume.

The extensive facilities and experienced technical staff of United States Plywood Corporation are at your disposal.

If you are interested in plywood — for any purpose — you will find the greatest variety under the Weldwood trademark. Present production includes the following types of plywood and plywood products:

Douglas Fir	Tempered Tekwood*	Armorply* Weldwood
California Pine	Northern Hardwoods	Low pressure plastics
Molded Weldwood	Southern Hardwoods	Tempreg*
Tekwood*		

*Registered trademarks

Weldwood

WELDWOOD Plywood

UNITED STATES PLYWOOD CORPORATION

World's Largest Producers of Plywood

616 West 46th Street, New York 19, N. Y. Branches in Principal Cities

QUALITY CONTROL

One of Many Reasons Why Amos Jobs are Done Right

WHETHER YOU NEED
PLASTIC PARTS
FOR ELECTRICAL APPLIANCES
OFFICE MACHINES OR INDUSTRIAL EQUIPMENT
Special Handles and Control Knobs for
TOOLS RADIOS AUTOS PLANES
CASES FOR CLOCKS CAMERAS JEWELRY
BATHROOM FIXTURES MEDICAL ACCESSORIES
Or Anything Else that's a Practical Plastic Application
You Get the Job Done Right by

To do plastic molding jobs right, one of the many requirements is quality control of production and finishing operations. Above you see one of the quality control stations in the Amos plant, where women with precision gauges check for uniformity of size and fit and tolerances required.

Quality control is but one of many reasons why Amos jobs are done right. Other reasons include—experienced engineering—the right plastics in the right places—perfect die work—adequate facilities for efficient production and accurate finishing.

From engineering to finishing, Amos does a complete job—and does it right. Just send us your drawings or write us what you have in mind to be molded in plastics.

AMOS MOLDED PLASTICS, EDINBURGH, INDIANA
Division of Amos-Thompson Corporation

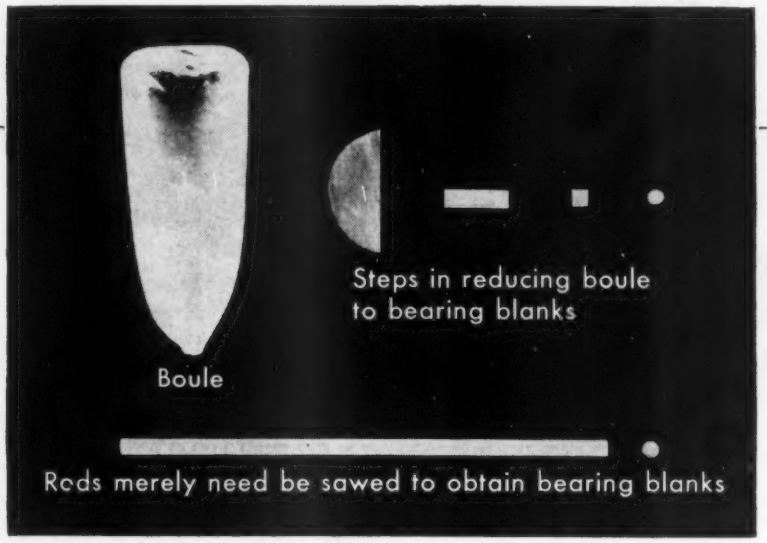
Amos
MOLDED PLASTICS...
Custom Molders of Parts and Products by the Injection Process

Linde

SAPPHIRE AND RUBY

(*Synthetic Corundum*)

Now Available in any Quantity, for any Purpose, without Priority



The advantage of the new rod form over the boule is illustrated here.

LINDE Sapphire and Ruby have been removed from W.P.B. allocation and can now be obtained without priority in any quantity for any use.

What They Are

LINDE Sapphire, water-clear corundum, and Ruby, red corundum, are crystalline forms of alumina. These materials offer a unique combination of properties to machine and product designers in many industries. They are single crystals second only to the diamond in mineral hardness and can be given a surface that is perfectly smooth. They are invaluable in bearings and many other parts where there is wear.

What Their Properties Are

Melting Point	2,050 deg. C.
Hardness, Mohs' Mineral Scale	9.
Tensile Strength	65,000 lb. per sq. in.
Chemical Resistance	Excellent
Thermal Conductivity	Low
Electrical Conductivity	Low

Where They Are Used

LINDE Sapphire and Ruby are now being used for such applications as: bearings, thread guides, extrusion dies, gages, knife edges, spray nozzles, oil-burner nozzles, wire guide dies, burnishing tools, pressure vessel windows, and electrical insulators.

How They Are Supplied

LINDE Sapphire and Ruby are supplied in half boules, weighing up to 150 carats and as rods of .070 in. to .125 in. diameter. More complete information will be sent on request.

BUY UNITED STATES WAR BONDS AND STAMPS

MARITIME "M" AWARD FOR OUTSTANDING PRODUCTION ACHIEVEMENT

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 E. 42nd Street UCC New York 17, N. Y.

The word "Linde" is a trade-mark of The Linde Air Products Company.

If the *Finish*

for your product must be

- **DURABLE**
- **ACID RESISTANT**
- **NON-CORROSIVE**
- **EASY-TO-CLEAN**
- **ABRASION-RESISTANT**
- **ATTRACTIVE—COLORFUL**

Specify

Porcelain Enamel

Modern Porcelain Enamel will economically provide the Permanent FINISH answer

. . . where your product must successfully combat acids, alkalies, alcohol, etc., corrosion, heat, serious climatic or atmospheric conditions and daily hard service.

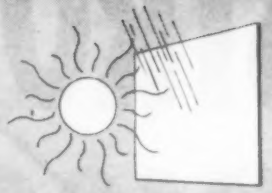
. . . where you need brilliant colors, soft pastels in rich combinations and attractive decorative effects, with a glass-smooth surface that needs only the swish of a damp cloth to forever keep it clean and sparkling.

. . . where you want a finish that is already known and recognized by consumers everywhere.

Write for "Handbook on Design and Fabrication of Metal Parts for Porcelain Enameling" which supplies important engineering data.

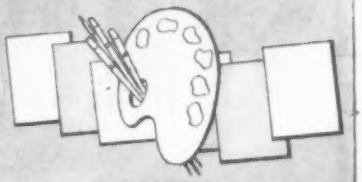
PORCELAIN ENAMEL INSTITUTE, Inc.
1010 Vermont Avenue, N. W.
WASHINGTON 5, D. C.

Porcelain Enamel is



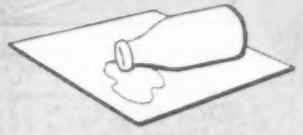
WEATHER-PROOF

EASILY CLEANED

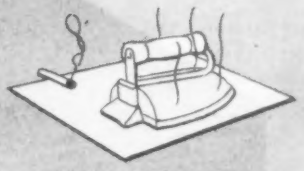


COLORFUL

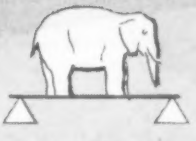
HARD AS GLASS



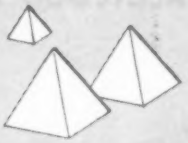
CORROSION RESISTING



HEAT-PROOF



STRONG



DURABLE

STRONG, SMOOTH, STABLE.

That's Formica Pregwood!

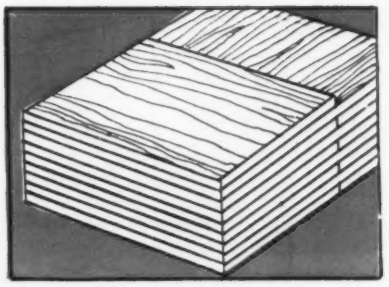
PREGWOOD is a relatively new material possessing many unusual qualities that have adapted it to many uses—such as switch gear in heavy duty switches, picker sticks on textile looms, ski bottoms on military skis.

The test figures shown below indicate the remarkable strength of the material—which has a lower specific gravity than aluminum.

Pregwood has a certain measure of efficiency as an electrical insulator. It is non-absorbent and does not take up moisture. It is chemically inert and can be used for apparatus parts that will be exposed to acids and alkalies.

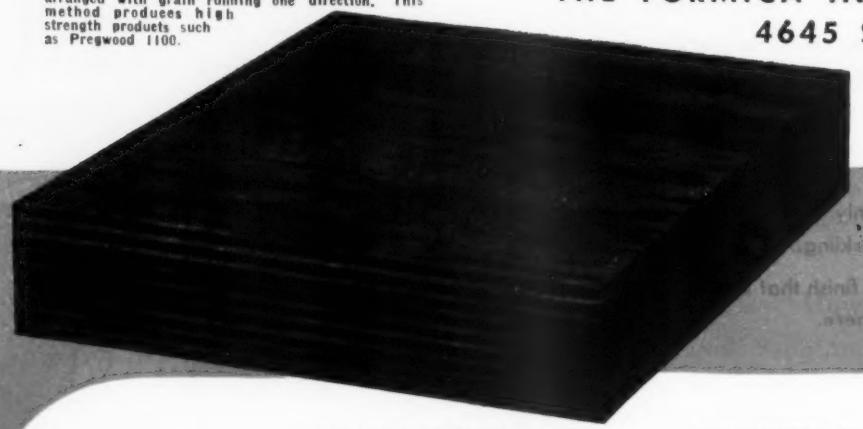
Changes in humidity have relatively little effect on dimensions; and a low co-efficient of thermal expansion holds the material stable under marked changes in temperature.

It has the quality of wearing smoothly without slivering or cracking. This makes it especially desirable for parts of textile machinery where it will not snag threads of fabrics.



Pregwood is built up by impregnating wood laminations with phenolic resins and pressing them together under heat and pressure. The laminations may be arranged with grain running one direction. This method produces high strength products such as Pregwood 1100.

THE FORMICA INSULATION COMPANY
4645 Spring Grove Avenue
CINCINNATI 32, OHIO



PREGWOOD 1100

TENSILE STRENGTH	COMPRESSIVE	IZOD IMPACT
#/sq. in. 30,000	#/sq. in. 20,000	Ft. Lbs./In. Notch Width
FLEXURAL #/sq. in. 48,000		Flatwise 7.0 / Edgewise 6.0

Test samples are available on request—

FORMICA

In One Product

ALL THE QUALITIES OF ENDURO PLUS ALL THE ADVANTAGES OF THE ELECTRUNITE PROCESS

That product is Republic ELECTRUNITE Stainless Steel Tubing.

It's made of Republic ENDURO—the time-proved stainless steel.

It is highly resistant to rust, corrosion and wear—and thus is indicated for chemical and industrial equipment. It may be used safely at elevated or sub-zero temperatures. It is ideal for food processing and handling equipment because it is clean, sanitary and easy to keep that way. Its silvery eye-appealing beauty helps to increase saleability of products in which appearance is important. And its original lustre lasts indefinitely.

Now, to these qualities add the high uniformity of wall thickness, diameter and roundness—the uniformly strong wall—which characterize tubing made by the ELECTRUNITE Process.

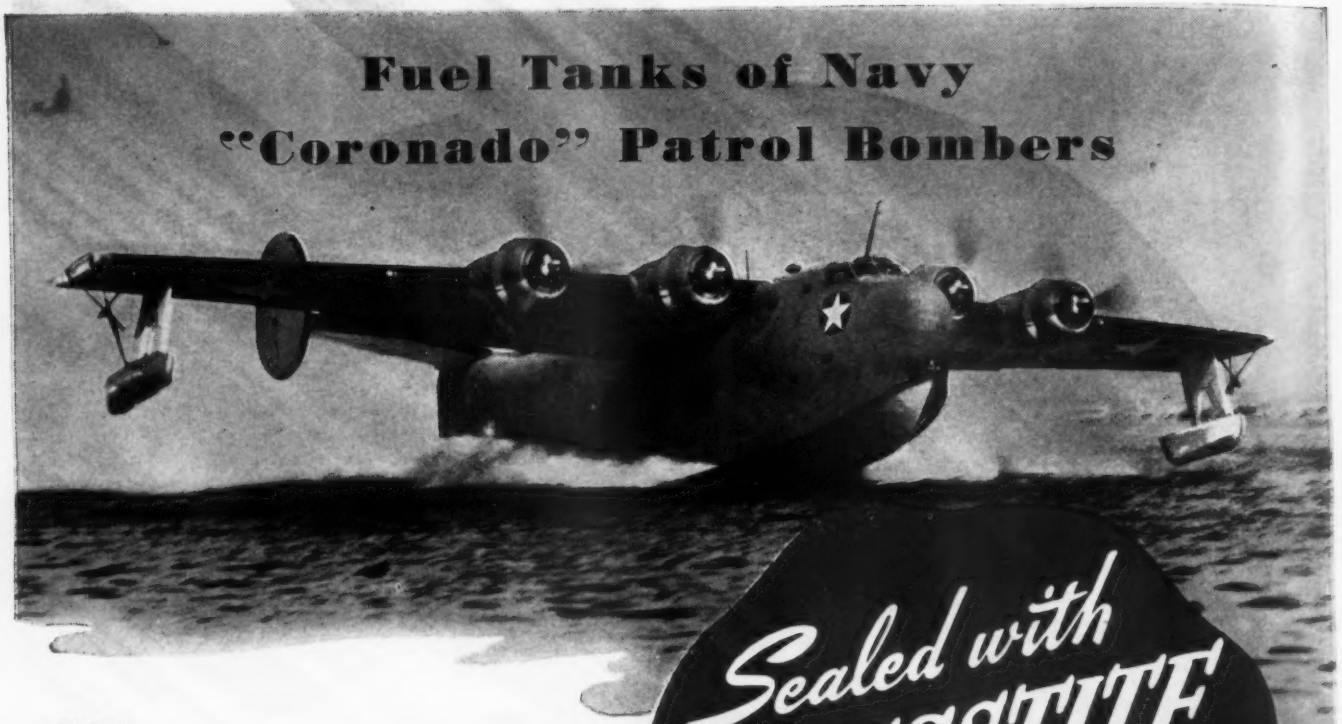
That's what you get when you specify Republic ELECTRUNITE Stainless Steel Tubing. It's made in a wide range of sizes and finishes. Write for detailed information.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Berger Manufacturing Division
Culvert Division • Niles Steel Products Division
Union Drawn Steel Division • Truscon Steel Company
Export Department: Chrysler Bldg., New York 17, N. Y.

Republic
ELECTRUNITE
Reg. U. S. Pat. Off.
STAINLESS STEEL TUBING

Also Carbon Steel Mechanical Tubing — Aircraft Tubing — Boiler, Condenser and Heat Exchanger Tubes

Fuel Tanks of Navy "Coronado" Patrol Bombers



Sealed with PRESSTITE SEALING COMPOUNDS

Many a tale has been told of the great work being accomplished by the Navy's PB2Y's—known as "Coronado" Patrol Bombers—in jobs ranging from bombing missions to heroic surface rescues. The fuel tanks of the Navy transport version of this type of plane, designated PB2Y-3R, are re-sealed by the Rohr Aircraft Corp. of Chula Vista, California.

Integral Fuel Tanks in these giant ships, the largest mass-produced plane in Navy service, are sealed with Presstite sealing materials using the Rohr Tank Seal Process. This method of sealing integral tanks, developed by Rohr Aircraft Corp., using these proven Presstite materials, represents the latest development in sealing tanks in large transport, cargo, and similar type planes.

Meeting the complex sealing requirements of the aircraft industry is only one example of Presstite's ability to originate and develop sealing compounds for specific requirements.

If your product or your manufacturing processes call for sealing or coating compounds, send your requirements to sealing specialists. We'll gladly work with you and your engineers in suggesting the most effective compounds to fit your needs.

PRESSTITE SEALING COMPOUNDS

PRESSTITE ENGINEERING COMPANY, 3956 Chouteau Avenue, St. Louis 10, Missouri

A Partial List of Industries for Which Presstite has successfully Developed Special Sealing Compounds:

For the Aircraft Industry:

Sealers for
- Integral Fuel Tanks
- Fuselage Seams
- Drop-off, Expendable Fuel Tanks
- Gun Turrets
- Synthetic Glass
- Instruments
- Intercoolers
- Air Ducts
- Insulating Dissimilar Metals
- Seaplane Floats

For the Refrigeration Industry:

Sealers for Domestic and Commercial Refrigerators

Bonding and Sealing Low Temperature Insulation in Refrigerated Rooms

For the Railroads:

Sealers for Insulating, Soundproofing and Weatherproofing of Railway Cars—Sealing Car Windows and Spot Welded Seams

For the Building Industry:

Roof Coatings, Caulking, and Waterproofing Compounds

For the Shipbuilding Industry:

Insulation Adhesive and Sealers—Rust Preventive Compounds

For the Automotive Industry:

Special Adhesives and Sealers

For the Construction Industry:

Sealers for Jointing Sewer Pipes

Sealers for Waterproofing Excavation Work

Miscellaneous:

For Glazing Greenhouse Windows

Extruded Caulking Compounds

Ammunition Paints

Plus Many Special Products for the Army and Navy

Our Engineering, Technical, and Laboratory facilities are at the service of any industry with a sealing problem.

YOU'LL be in good company when you specify General Industries molded plastic parts or low-torque electric drives, or both. From one plant, under one management, we supply both these products to the most rigid specifications.

YOU CAN SPECIFY *BOTH* FROM GENERAL INDUSTRIES

In our molded plastics division, we have the know-how to do large or small jobs, simple or intricate, in any quantities. While we don't attempt to design or redesign your parts, our skilled and co-operative team of engineers, mold makers and machine operators frequently make suggestions for better, faster or lower cost moldings that will meet or beat your specifications.

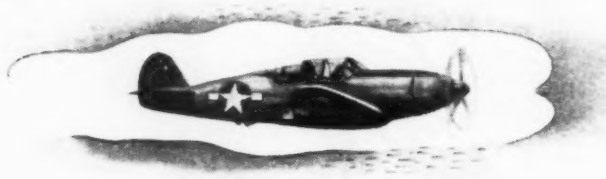
You'll find similar ability in our small motors division. For years, we've built *Smooth Power* drives for our own lines of recorders, record-changers and turntables, and for electric and electronic products of leading manufacturers. If one of our many standard motors or drive assemblies won't meet your specifications, we'll design and build one that will, exactly.

So, if you're specifying molded plastics or small motors, we'd like to work with you. Definite commitments must wait until the end of our military work is in sight, but a start now may help you get to the markets quicker with your postwar products. It will be appreciated if you will address the specific division . . . *molded plastics* or *small motors*.

THE GENERAL INDUSTRIES COMPANY
ELYRIA, OHIO

ARMY E NAVY

HOW
Flex-O-Tubes
SERVE IN THE AIR

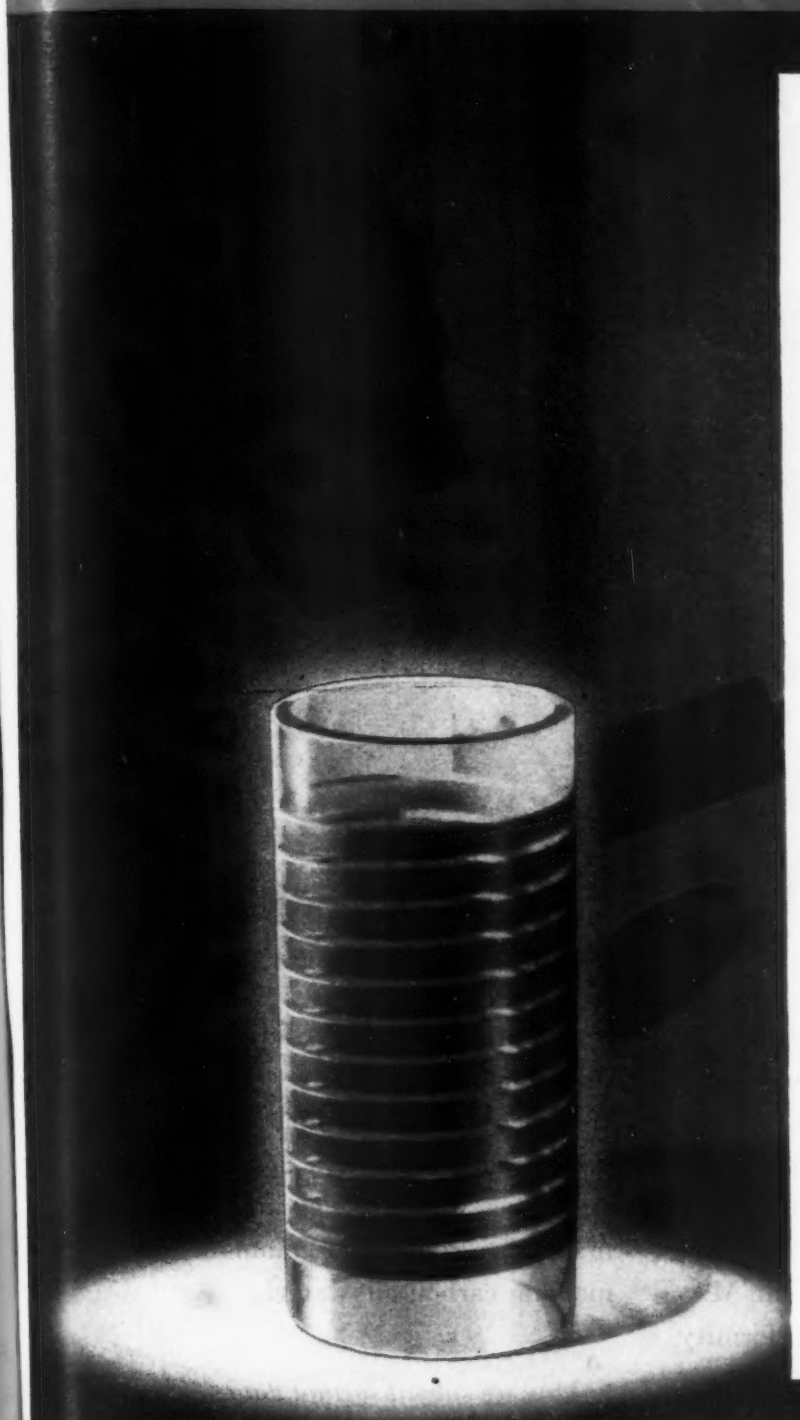


AUTOMATIC PILOT ACTUATION
BOMB DOOR CONTROLS
CONTROL SURFACE BOOSTER
COWL FLAP CONTROLS
DE-ICER HOSE
FUEL AND OIL LINES
GUN MOUNT CONTROLS
HYDRAULIC BRAKES
HYDRAULIC GUN CHARGER
HYDRAULIC GUN TURRETS
HYDRAULIC RUDDER CONTROLS
HYDROMATIC PROPELLER CONTROLS
INSTRUMENT LINES
OXYGEN FEED LINES
PUMP CONNECTORS
RETRACTABLE LANDING GEAR
RETRACTABLE LANDING LIGHTS
RETRACTABLE NOSE WHEEL
RETRACTABLE TAIL WHEEL

THE **Flex-O-Tube** COMPANY

LAFAYETTE at 14th AVE.,
DETROIT 16, MICHIGAN
Offices: CHICAGO · FORT WORTH
LOS ANGELES · NEW YORK
SEATTLE · TORONTO, ONT.

Have you looked into METALLIZED GLASS?



YOUR electronic problems may find an answer in Corning's process for permanently bonding metal to glass.

Which of the following qualities will help you?

1. **Hermetic** bond between glass and metal — assures positive and permanent seal against oil, water, and gas.

2. **Precision** metallizing — allows accurate control of capacitance, inductance, or resistance.

3. **Permanent** mechanical and electrical qualities — maintain accurate tolerances indefinitely.

4. **Superior electrical properties** of glass — low power factor, high dielectric strength, extremely high resistance, wide range of dielectric constants.

5. **Thermal endurance** of a high order. Metallized glass easily meets Army and Navy specifications for thermal shock.

• • •

Write us about your problems. We'd be interested in seeing if glass can help you. Address Electronic Sales Dept. R-1, Corning Glass Works, Corning, N. Y.

CORNING *means* Research in Glass

Electronic Glassware

CORNING REG. U.S. PAT. OFF. PYREX REG. U.S. PAT. OFF.

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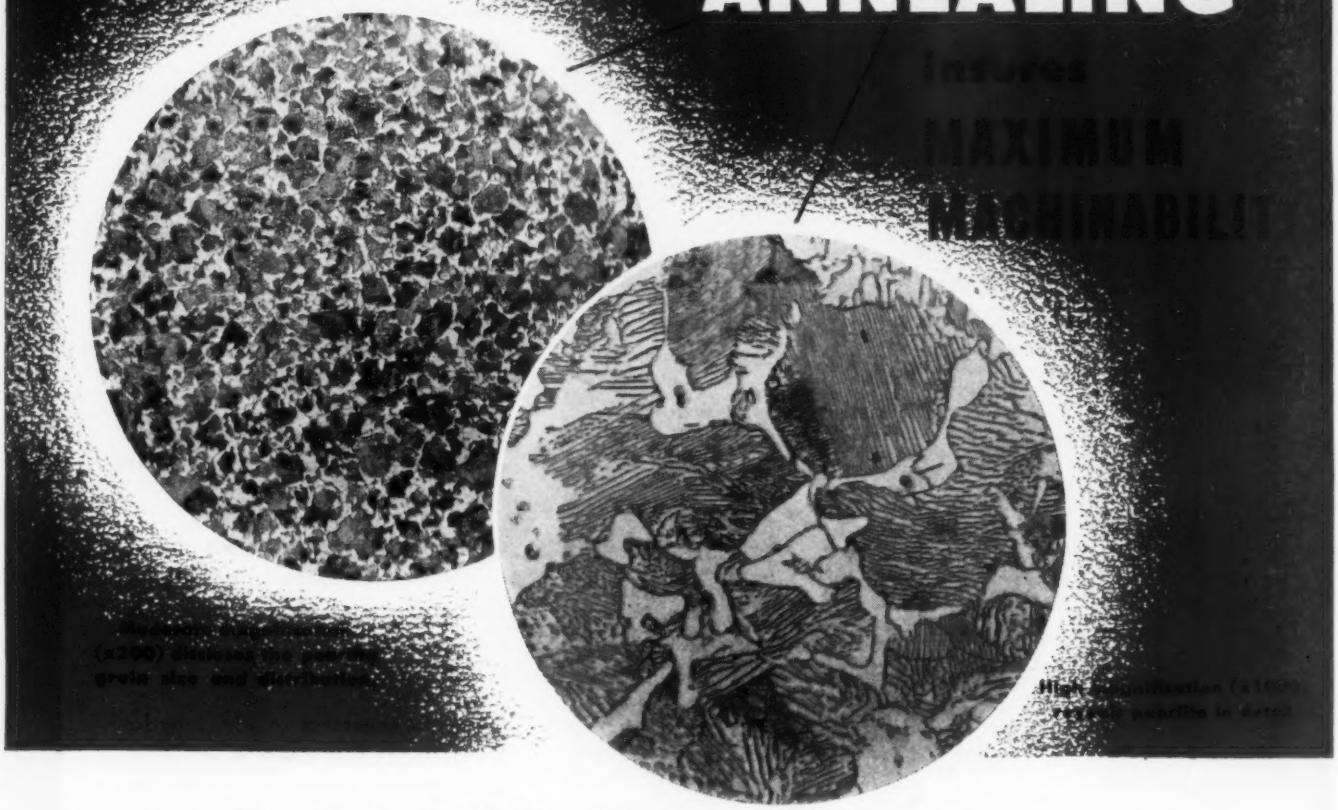
WYCKOFF

Structure Controlled ANNEALING

Insures MAXIMUM MACHINABILITY



MAXIMUM MACHINABILITY of ANNEALED STEELS requires the continual reproduction of a UNIFORM STRUCTURE by the annealing treatment. • The elimination of undue variations in STRUCTURE is a contribution toward more uniform MACHINING RESULTS. • Uniformity of structure also contributes to more uniform response to further heat treatment. The accompanying photomicrographs show a reproducible structure which is giving excellent machining results on commonly used medium carbon alloy steels.

May we submit factual data covering the desirability of Structure Controlled Annealing?

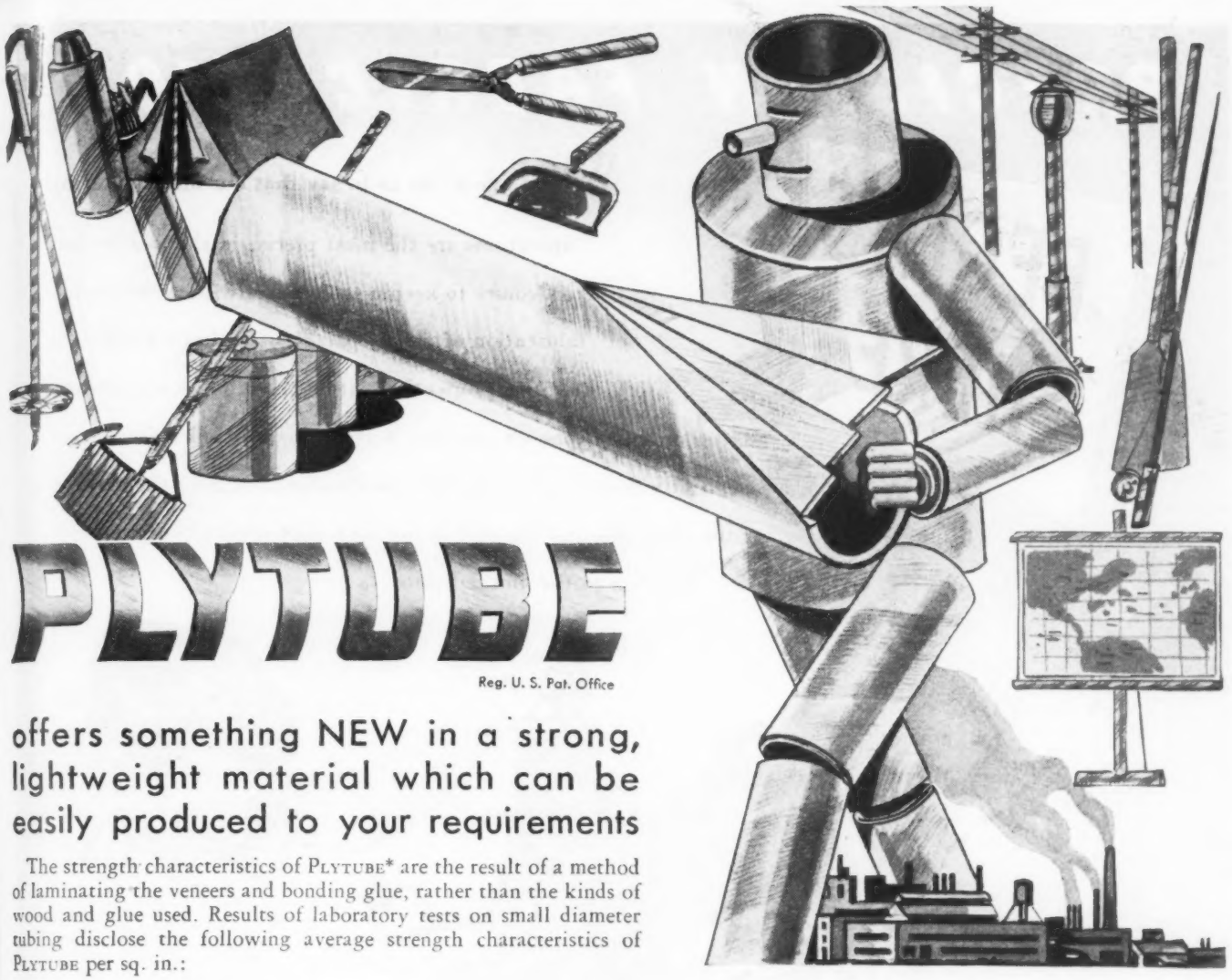
ARMY E NAVY

WYCKOFF STEEL COMPANY

General Offices: PITTSBURGH 30, PENNA.

Works:
Ambrige, Pa. Chicago, Ill. Newark, N.J. Putnam, Conn.

COLD FINISHED STEEL WYCKOFF



PLYTUBE

Reg. U. S. Pat. Office

offers something NEW in a strong, lightweight material which can be easily produced to your requirements

The strength characteristics of PLYTUBE* are the result of a method of laminating the veneers and bonding glue, rather than the kinds of wood and glue used. Results of laboratory tests on small diameter tubing disclose the following average strength characteristics of PLYTUBE per sq. in.:

Ultimate Compressive Strength	11,500
Ultimate Tensile Strength	11,000
Compressive Proportionality Limit	6,000
Tensional Proportionality Limit	6,000
Deflection, Young's modulus	1,500,000
Axial Expansion, Young's modulus	1,700,000
Buckling Failure, Young's modulus, Euler's formula	11,000
Specific Weight (approx.)	0.75

PLYTUBE has already been put to valuable, effective use. Applications thus far made predict fields of utility in which its great strength and light weight can be taken advantage of in improving product design, construction and manufacture. Fabrication is simple and economical. Handling is greatly facilitated because of its form and lightness in weight.

All the advantages of PLYTUBE as a material of construction can be made available in countless ways in an almost unlimited variety of products. These advantages are of such importance as to command your careful investigation. A study of the possibilities of PLYTUBE *now* will open up applications for its use that can well revolutionize your future manufacturing plans. Our engineers are prepared to work with you on your ideas and apply our research facilities in developing whatever uses you consider advantageous. Ask for further data on PLYTUBE, using coupon below. Samples will be sent on request.

PLYMOLD CORPORATION
Lawrence, Mass.

Characteristics:

High Mechanical Strength
Corrosion Resistance
High Dielectric Strength
Wide Variety of Sizes
Easy Workability
Low Costs

*Manufactured under U. S. Pat. No. 2,352,533, exclusively by Plymold Corp.

P.E. 1-45

PLYMOLD CORPORATION
Lawrence, Mass.

Please send me further engineering data and information about Plytube.

Name.....

Company.....

Street.....

City.....State.....

PRECISION FABRICATION

BEGINS HERE

We won't go so far as to say that our manufacturing operations are the most precise in the world—but when it comes to keeping tolerances within .001 in the fabrication of plastic parts—well, that's a different story. Precision fabrication within these limits is a routine matter on many jobs we produce. Accuracy is controlled from start to finish and strictly according to customer specifications . . . from the making of the jigs, dies and fixtures in our own tool department right on through to the finished piece.

Send us the specifications for your *next* fabricated part and let us prove to you that we can produce it *better . . . faster* and *more economically!* You are also invited to use the facilities of our engineering department either for consultation or design ideas pertaining to your parts requirements.

Precision
FABRICATORS, INC.
EAST ROCHESTER, N. Y.

Specification Fabricators of
VULCANIZED FIBRE, CORK, CORPRENE, PHENOL FIBRE, RUBBER, ASBESTOS AND OTHER MATERIALS
Branch Offices:
DETROIT: 4835 WOODWARD AVE. CHICAGO: 4317 RAVENSWOOD AVE.

To protect your product against costly failures due to

WEAR
IMPACT
FATIGUE
CORROSION
. . . use parts of
AMPCO
Metal
. . . an engineered alloy of closely controlled quality, from the only completely-equipped, self-contained source of aluminum bronze parts
Nowhere else can you obtain all of these benefits, to enhance the salability, performance, and reputation of your product:

1 A material with distinctive properties of resistance to wear, impact, fatigue, corrosion . . . capable of lasting several times as long as ordinary bronzes.

2 An engineered alloy . . . with physical properties designed to fit the specific application, on the basis of over 30 years of specialization . . . including experience with the requirements of more than 2,000 customers in diversified industries.

3 Quality control to hold these properties within narrow limits . . . and the specialized experience necessary to produce to a super-standard.

4 Diversified production facilities, concentrated and coordinated in one place, for working the metal by every metalworking process in general use, including:

Sand Casting	*Extrusion*
Centrifugal Casting	*Welding (with Ampco-Trode)*
Forging	*Precision Machining*

. . . thus making available a complete, self-contained parts source.

5 Engineering and production "know-how" for converting your designers' drawings into a practical manufacturing proposition, at a per-piece cost commensurate with results.

6 A nation-wide organization of field engineers, capable of assisting you in this specialized aspect of the modern trend toward engineered materials.

7 A record of proved performance under severe conditions, in war and peace, as original equipment in hundreds of leading makes of machinery and equipment.

8 A national reputation which makes Ampco Metal parts a sales asset for any equipment in which they are employed.

Send us your prints when you are ready to consider materials. Write for bulletins. ***Ampco Metal, Inc., Dept.*** **PE-1,** ***Milwaukee, Wis.***

Ampco Field Offices in Principal Cities.

AW-10

AMPCO Metal
The Metal without an Equal

SEND FOR THIS TEST PANEL

See for yourself how Iridite licks corrosion problems, adds lasting beauty to zinc or cadmium plating.

MAIL the coupon below for this free test panel of Iridite-protected zinc plating. Have your laboratory give it any corrosion test you want. Watch Iridite "take it" and come back for more. Then you'll see for yourself why Iridite is so widely used as a corrosion-resistant final finish by such manufacturers as Western Electric, Otis Elevator, Bulova, Pyrene, Anaconda and many others.

Watch, too, as you're testing it, how the color holds up . . . remains a uniform shade. And remember, Iridite is available in a wide range of colors, adding to products the sales appeal that comes from attractive appearance. Also, because of Iridite's excellent qualities as a paint base, all colors can be clear-lacquered for even greater durability!

Finally, in running your tests, bear in mind the simplicity of the Iridite process. Applied by brief dipping at normal shop temperature, Iridite dries in a few seconds, permits immediate handling, packing and shipping. No slowing up of fast-moving production lines working to fill war or civilian orders! No wonder so many manufacturers specify Iridite for the zinc or cadmium surfaces of their present and future products!

SEND FOR YOUR SAMPLE TODAY

Here's the coupon that will bring you a free sample to test in your own laboratory . . . with *your* products in mind. We urge you to mail it today . . . and see for yourself that widely-specified Iridite can be just the right "finishing touch" for *your* products.

QUICK FACTS ON IRIDITE

Corrosion Resistant. Iridite unites chemically with zinc or cadmium, forms a corrosion-resistant surface.

Firm Paint Base. Iridite holds paint permanently—prevents formation of that soapy, chalky under-layer that destroys adhesion.

Dimensions Unaltered. The Iridite process does not alter dimensions of the most finely machined or delicately articulated parts. Assemblies function as smoothly after Iridite treatment as before.

Completely Flexible. Iridited parts may be bent or twisted without flaking, chipping or peeling.

Easy to Apply. Iridite is applied by simple dipping immediately after the last rinse tank in the plating line. Parts dry in a few seconds, permitting immediate handling, packing and shipping.

Many Attractive Colors. Currently available are blues, greens, maroons, bronze, olive drab and black. All colors can be clear-lacquered for even greater durability.

Rheem Research Products, Inc.,
301 Chemical Bldg., 2523 Pennsylvania Ave.
Baltimore 17, Md.

Gentlemen: Please send me a free sample of Iridite-treated zinc plating for laboratory testing, together with full information and operating details.

Name .....

Company .....

Address .....

.....

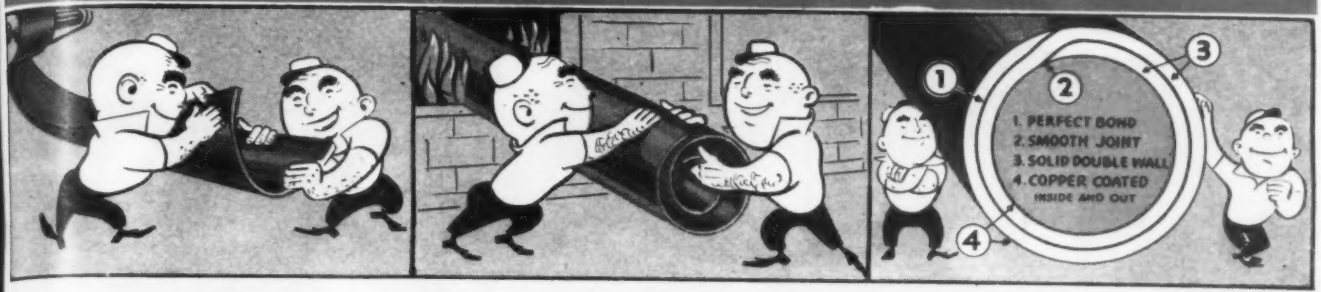
RHEEM RESEARCH PRODUCTS, INC.

IRIDITE

2523 Pennsylvania Ave., Baltimore, 17, Md.

Branch Offices—Chicago, Ill.; Los Angeles 15, Cal.; Distributors: MacDermid Incorporated, Waterbury 88, Conn.; J. C. Miller, Grand Rapids 4, Mich.; Wagner Bros., Detroit 2, Mich.; McGean Chemical Co., Cleveland 15, Ohio; The Udylite Corporation, Long Island City 1, N. Y.; Sommers Bros. Manufacturing Co., St. Louis 7, Missouri.

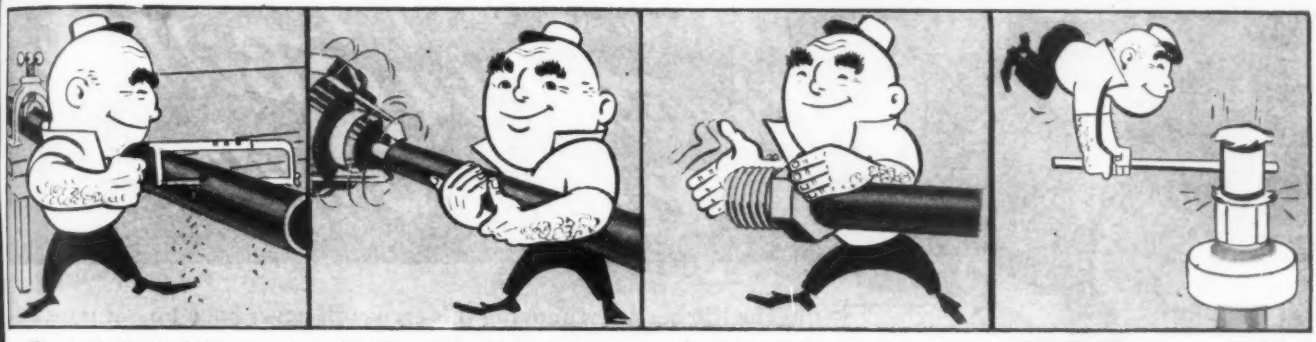
FABRICATING A TYPICAL BUNDYWELD LIFE LINE



1 The **Bundyweld** Steel Tubing is made by a process **entirely different** from that used in the making **of any other tubing. A** single strip of copper-coated S.A.E. 1010 steel is continuously rolled twice around laterally into tubular form.

2 **Walls of uniform** thickness and concentricity **are assured** by the use of close tolerance cold rolled strip. This double rolled strip is next passed through a brazing furnace where the copper coating fuses and alloys with the double steel walls.

3 **After brazing** and cooling, the tubing has become a perfectly bonded SOLID double wall steel tube, completely copper brazed throughout 360° of wall contact, copper coated inside and out, free from scale and closely held to dimensions.

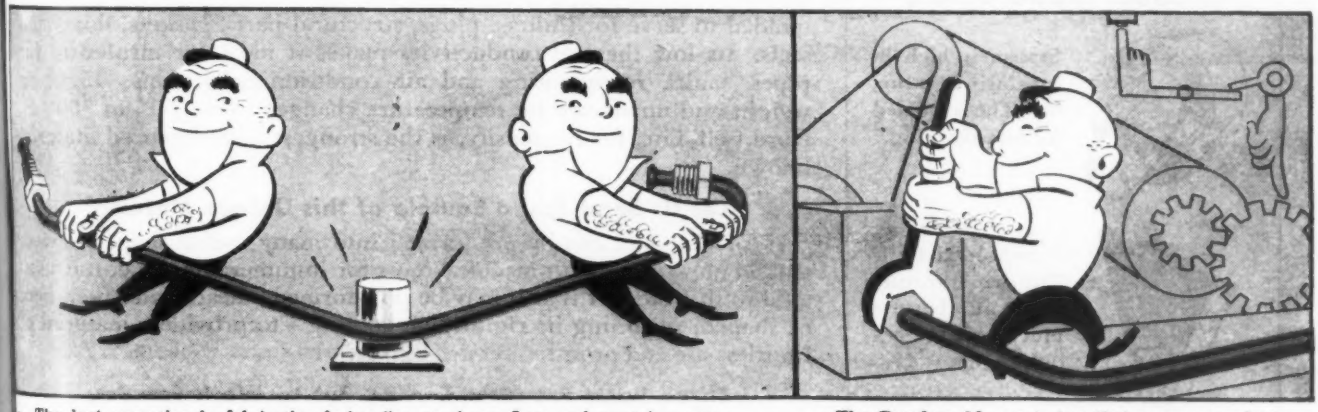


4 The **next step** in fabrication of a Bundyweld **part is** cutting to length, which **is done at the** Bundy plant on a **circular saw, or,** in the field, with **any tube cutter** which may be **available.**

5 **The ends** of the tube are burred with a specially designed tool with cutting edges of high speed steel which removes both inside and outside burrs in one operation.

6 **Next,** fittings are assembled. Any of the standard flare, compression type or soldered fittings may be used. Where flare type fittings are used, the Bundy Double Flare is recommended.

7 **The Bundy** Double Flare, which has been adopted as a standard by the S. A. E., safely permits frequent removal and replacement of fittings, as well as over-torqueing.



8 The last operation in fabrication is bending to shape. Last and most important . . .

9 **The Bundyweld** part is installed on *your* product.

Bundyweld Steel Tubing is furnished hard or annealed in standard diameters and gauges up to 5/8" O. D. Special sizes cold drawn as desired. Bundyweld is also furnished in Monel. For complete information, contact our nearest representative or write Bundy Tubing Co., Detroit 13.

BUNDY TUBING

ENGINEERED TO YOUR EXPECTATIONS

BUNDY TUBING DISTRIBUTORS AND REPRESENTATIVES:

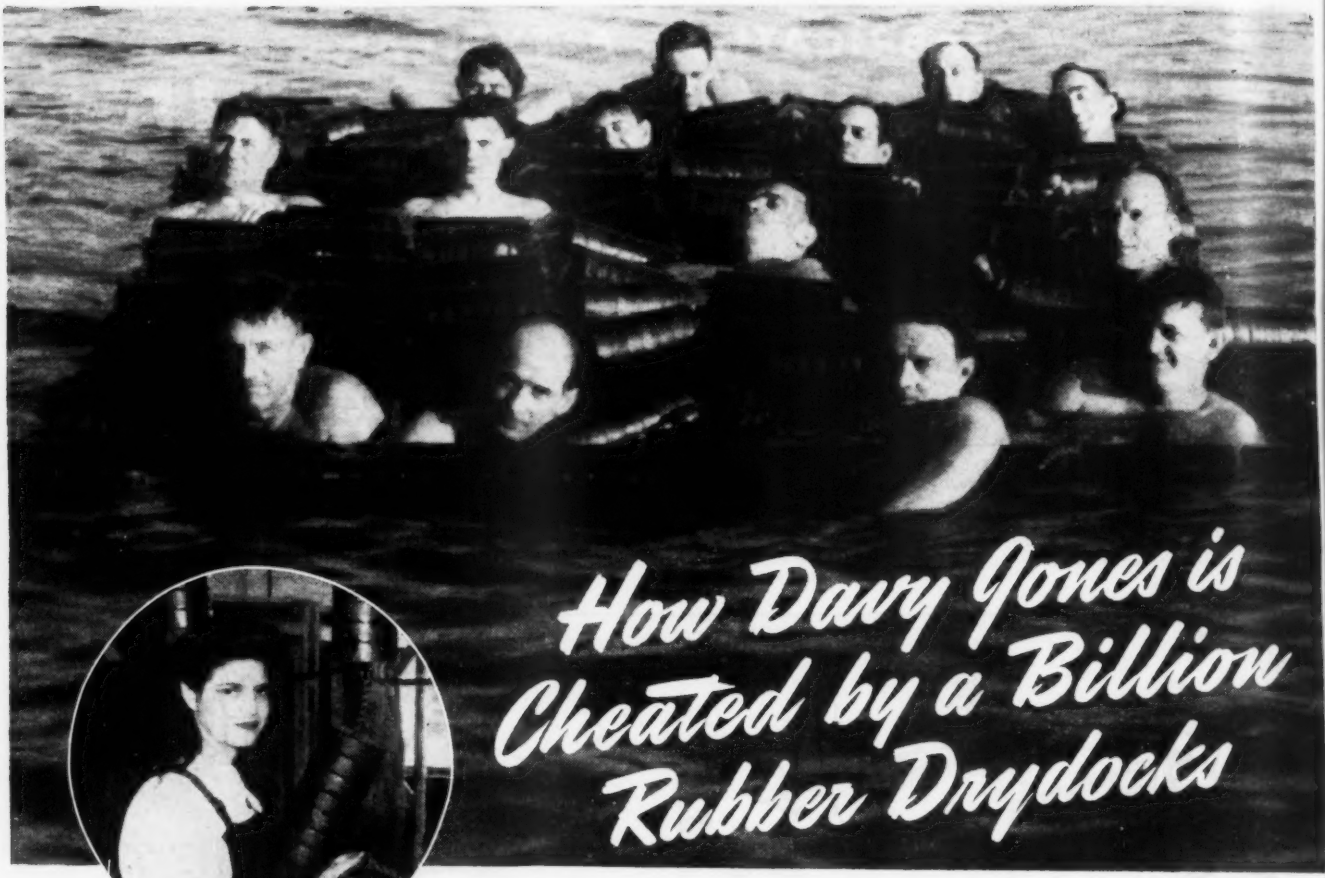
Pacific Metals Company, Ltd.
3100 19th Street
San Francisco 10, California

Standard Tube Sales Corp.
1 Admiral Avenue
Maspeth, New York City, N. Y.

Lapham-Hickey Company
3333 W. 47th Place
Chicago 32, Illinois

Rutan & Company
112 South 16th Street
Philadelphia 2, Pennsylvania

Eagle Metals Company
3628 East Marginal Way
Seattle 4, Washington



How Davy Jones is Cheated by a Billion Rubber Drydocks

The life net floats buoying this crew will never open up, saturate, rot or sink! A billion tiny Cell-Tite* drydocks – tight-walled, gas-filled cells of hard rubber – defy time, tide and climate indefinitely.

This rigid yet highly formable Hard Cell-Tite offers many interesting possibilities for everyday use. It is resistant to a wide variety of gases, solutions, acids, oils and solvents. For special applications it can be molded to serve for linings, plugs, structural parts, gaskets, floats and seals. Its low thermal conductivity makes it ideal for insulation for pipes, tanks, refrigerating and air conditioning systems. Light in weight and unaffected by temperature changes from –60° to 300° F., Hard Cell-Tite, for its density, is the strongest manufactured material known.

Let Us Send You a Sample of this Unique Material

Hard Cell-Tite can be pre-formed into many useful shapes, sawed, drilled or worked with machine tools for innumerable structural uses. Add to this the fact that it may be post-formed – heated and then bent or shaped, regaining its rigidity on cooling – to provide a material of limitless use and profit!

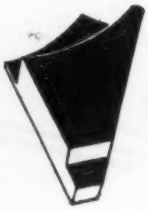
Three Basic Products Can Be Put to Work for You

Experienced in compounding rubber in cellular form for more than 21 years, our chemical and engineering staff is ready to apply Cell-Tite or our other basic products, Spongex* (resilient sponge rubber), or rubberized curled hair, to make your product more useful, efficient and economical. We have ample production facilities to meet your present and postwar purposes. Describe your needs or prospective plans and the experience of our organization is yours.

*Trade Mark Registered

CELL-TITE
has a host of uses in product manufacture

Extremely high in insulation value, Cell-Tite is molded for pipe covering.



Pre-molded Cell-Tite shapes are useful in numberless mechanical requirements.

Hard Cell-Tite can be thermoplastically formed to many shapes. It resumes its rigidity when cooled.

Sponge Rubber Products Co.

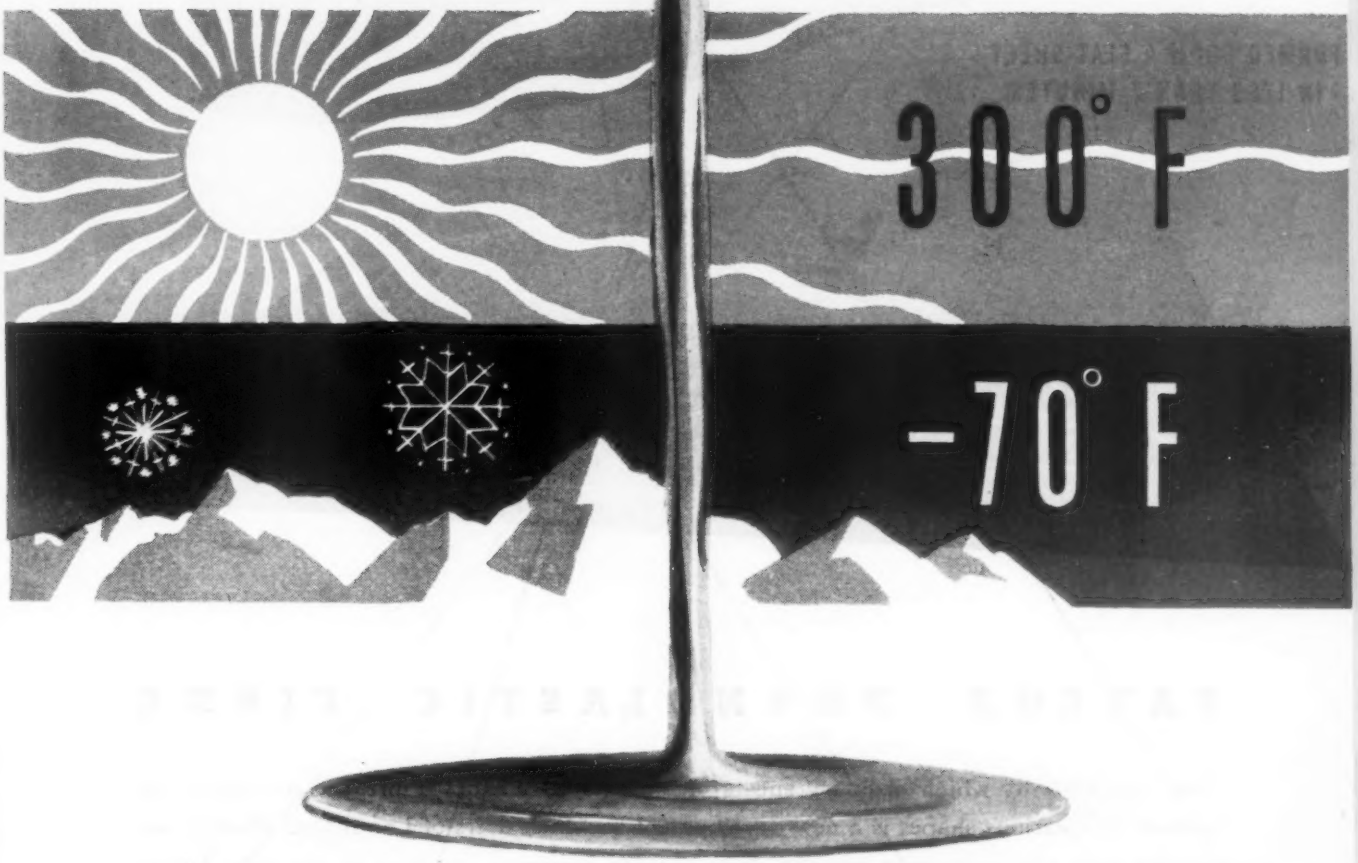
123 Derby Place, Shelton, Connecticut

Sales Offices: **New York • Chicago • Washington • Detroit**

WORLD'S LARGEST MANUFACTURER OF CELLULAR RUBBER PRODUCTS

DC FLUIDS

Fluids . . . that stay fluid all the way!



In numerous engineering and technical uses, including precision instrument applications, the new liquid organo-silicon-oxide polymers known as Dow Corning Fluids are proving their marked superiorities over conventional oils.

These water-white mobile liquids remain fluid at arctic temperatures, and exhibit unusually low rate of viscosity change over a wide temperature range. They are heat stable, neutral in reaction, chemically inert, non-corrosive to metals.

The dielectric constant of the nonvolatile DC Fluids (those above 20 centistokes) is 2.7 to 2.8 and their dielectric loss is exceptionally low, remaining at less than 0.0001 over a wide frequency range. Inquiries for detailed information are invited.

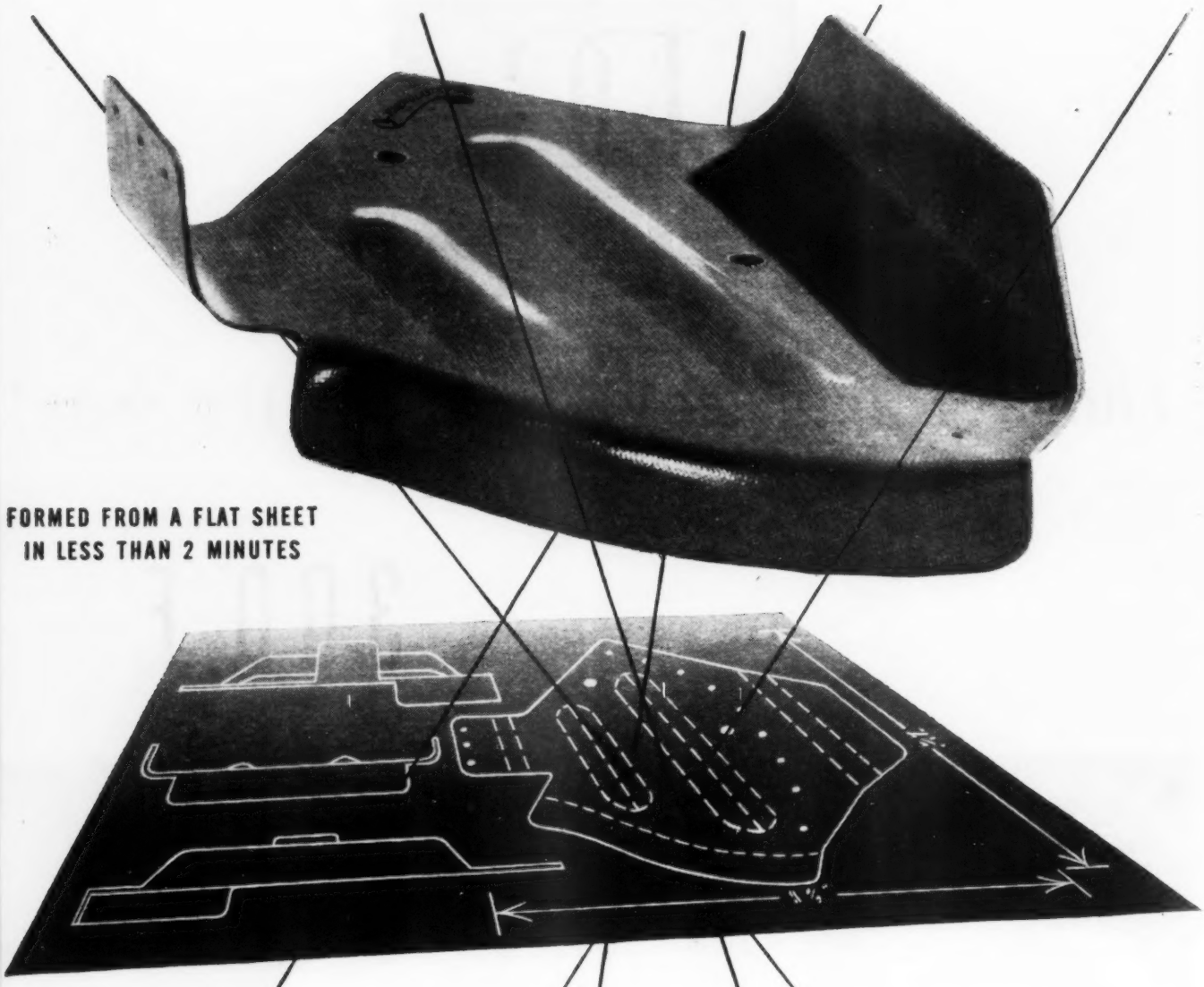
DOW CORNING CORPORATION
BOX 592, MIDLAND, MICHIGAN

DOW CORNING FLUIDS COME IN TWO TYPES

TYPE 200—commercially available in five viscosity grades—100 200, 350, 500 and 1,000—in centistokes at 25°C.

TYPE 500—commercially available in ten viscosity grades—0.65 1.0, 1.5, 2.0, 3.0, 5.0, 10, 20, 50 and 100—in centistokes at 25°C

Dow Corning



FORMED FROM A FLAT SHEET
IN LESS THAN 2 MINUTES

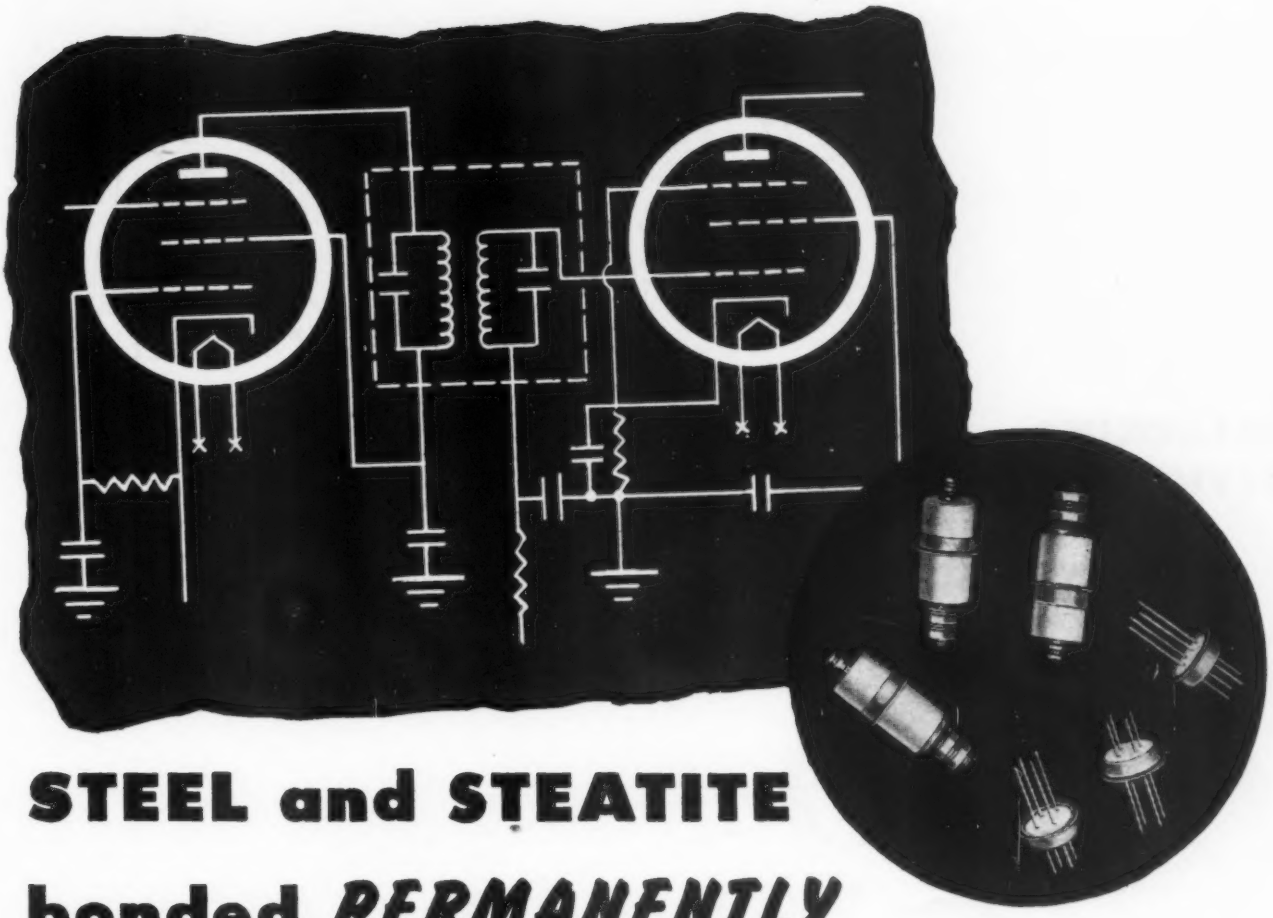
TAYLOR PHENOLASTIC FIBRE

THE METHOD by which ordinary sheets of fully-cured Phenol Fibre are re-heated and formed into various shapes is a new development to which users of Laminated Plastics are turning with ever-increasing interest. Now, Taylor engineers, working in the new Taylor Research Laboratory, have developed a *special* fibre which forms *better* and *easier* than standard grades of Phenol Fibre. This new development is called Taylor *Phenolastic Fibre*—a Phenol Fibre with special, elastic qualities. This new product has many advantages. Unlike metal, Phenolastic Fibre is not reduced in section at the maximum point of draw. Shapes involving compound curves and comparatively deep draws are easily made with no sacrifice in the strength of the material. Send us the facts about your product and our engineers will gladly tell you whether it can be made easier or better or more economically with Taylor Phenolastic Fibre.

TAYLOR FIBRE COMPANY

LAMINATED PLASTICS: PHENOL FIBRE · VULCANIZED FIBRE · Sheets, Rods, Tubes, and Fabricated Parts

NORRISTOWN, PENNSYLVANIA · OFFICES IN PRINCIPAL CITIES · PACIFIC COAST HEADQUARTERS: 344 S. SAN PEDRO ST., LOS ANGELES



STEEL and STEATITE bonded *PERMANENTLY*

The high mechanical strength of steel and the excellent, permanent insulation qualities of STEATITE have been combined by General Ceramics through its development of a new method of hermetically sealing and permanently bonding together STEATITE and metals in various combinations.

These SEALEX combinations successfully withstand the most severe temperature changes, and show no vibration fatigue. The metal parts are tinned to facilitate soldering where desired.

The General Ceramics method of fusing steatite and steel solves the problems of hermetically sealing and permanently protecting equipment against moisture.

For long-life, dependable, efficient service specify "Steatite" and "Sealex" Combinations.

ARMY E NAVY

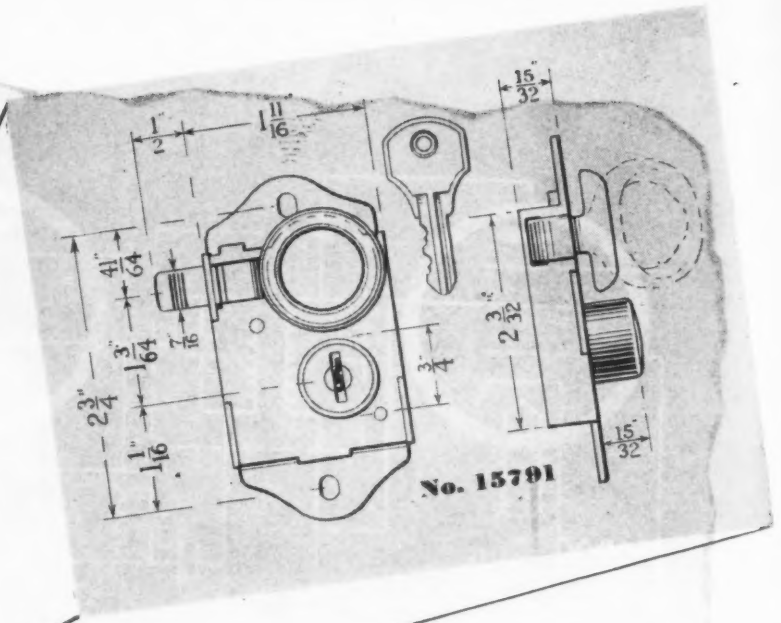
General Ceramics

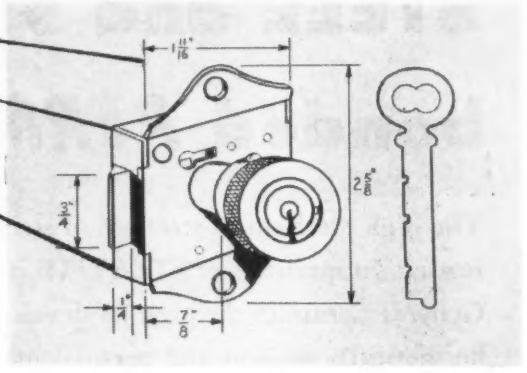
AND STEATITE CORP.

GENERAL

KEASBEY
NEW JERSEY

IN LOCKING DEVICES . . .





LET CORBIN BACK UP WHAT YOU PUT DOWN!

No matter how strikingly original the design . . . or how unusual the installation . . . a Corbin Lock engineer can "expedite" the job and provide vital help in seeing it through. And back of the engineer is a 62 year tradition of Corbin craftmanship embracing thousands of locking devices of every nature to assure you that the know how "sparked" on your drafting board *comes out in the finished product!*

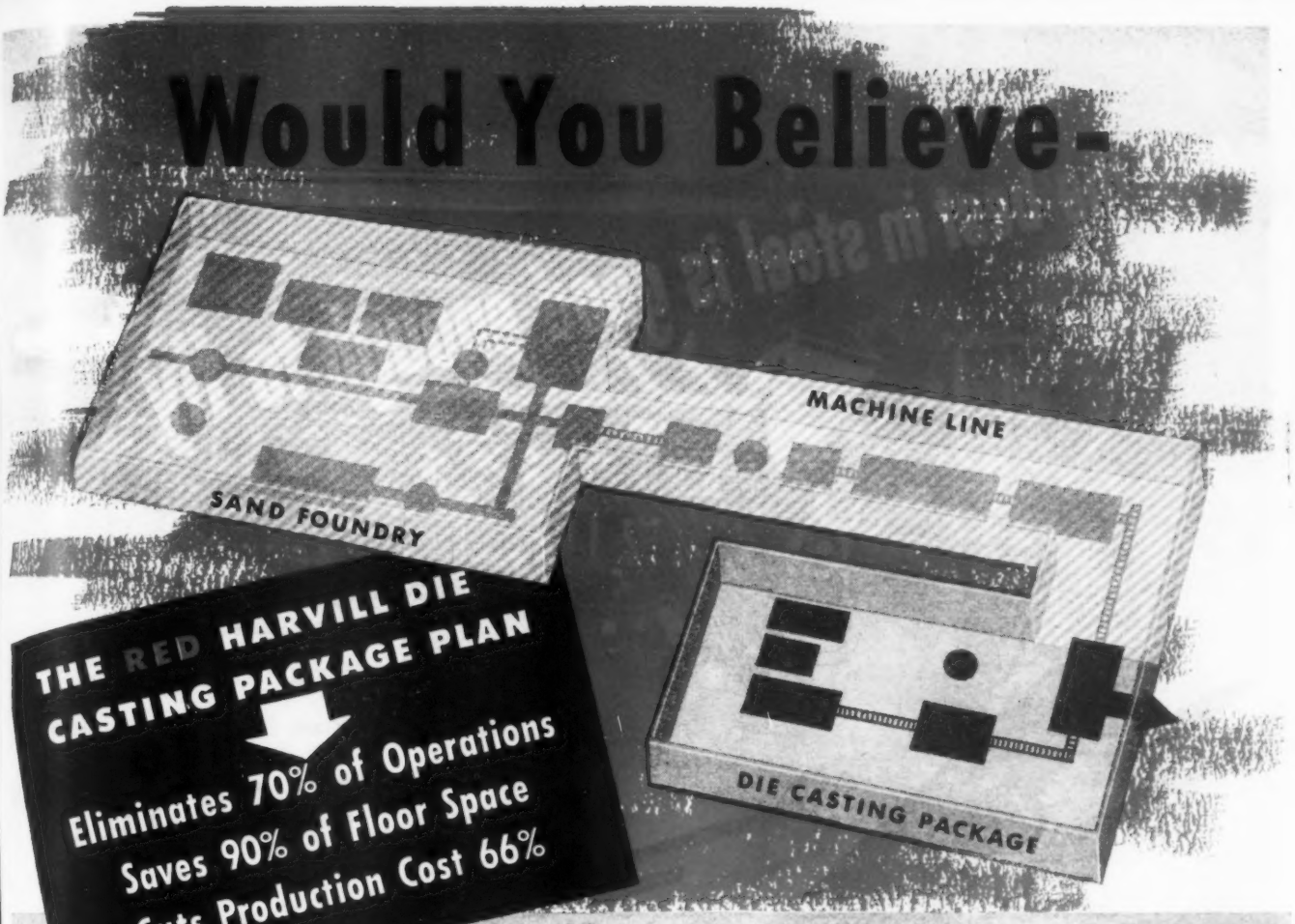
When stock designs are called for, our "Industrial Catalog" can provide quick "on-the-spot" suggestions. We will be happy to send you a copy if requested on your business letterhead. Or, if you prefer, mail us your blueprint for study and recommendations.

CORBIN

CORBIN CABINET LOCK CO.
NEW BRITAIN CONNECTICUT
THE AMERICAN HARDWARE CORPORATION, SUCCESSOR

"Safety first....and last....when Corbinlocked"

Would You Believe—



THE RED HARVILL DIE CASTING PACKAGE PLAN

Eliminates 70% of Operations
Saves 90% of Floor Space
Cuts Production Cost 66%

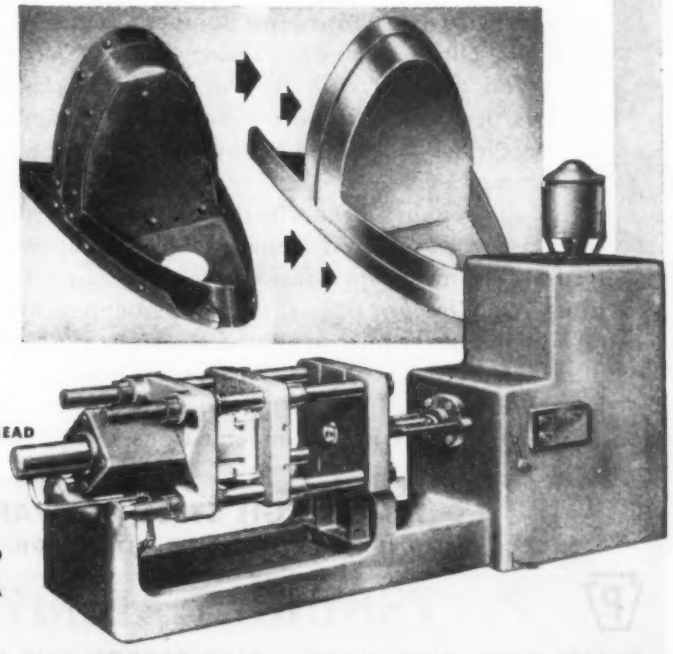
Yes, it's true—actual layout of a production line involving ten operations showed 7 could be eliminated by substituting the Harvill die casting machine package. Plus advantages include lower capital investment, lower inventories and increase in daily output. A cure for the "Reconversion Jitters" for this company!

See RED and be ready

If you manufacture from metal, discuss your plans now with Red Harvill and be ready to meet stiff competition in your post-war market by the use of die casting as your newest machine tool.

Die Casting Saved 38%

Case History No. 78. Sheet assembly of 6 pieces (left) requiring 30 rivets converted to one-piece die casting at saving of 38% and weight reduction of 27%. "Red" can do the same for you.



WRITE TODAY FOR BROCHURE ON FIRM LETTERHEAD

H. L. RED HARVILL MFG. CO.

POST OFFICE BOX (335-A) VERNON, CALIFORNIA

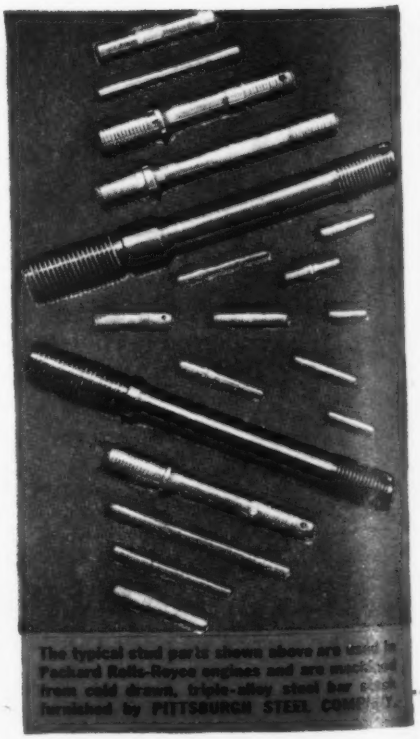
Pittsburgh Alloy Steel is used in Packard-Built Engines

IN the speedy Mustang that slashed cross-continent in a record breaking 6 hours, 31 minutes, *Pittsburgh Alloy Steel* went along for the ride. And when a Mosquito Bomber thundered Labrador to London in a time-clipping lunge, *Pittsburgh Alloy Steel* was ticking off the miles and minutes with it. For in the Packard-built Rolls-Royce engines that power these famous ships, precision parts made from Pittsburgh "aircraft quality" alloy bars, wire and tubing function vitally.

So what?

So *again* it has been clearly demonstrated that *open-hearth* alloy steel, as produced by Pittsburgh Steel Company, has achieved perfection that meets specifications for the toughest alloy steel applications. Only the *best* in steel is good enough to fly!

When your requirements for alloy grades combine the problems of manufacturing economy, *Pittsburgh* Alloy Steel, made by the Open-Hearth Process, can often fill the need exactly. Send us your specifications for analysis, recommendations and pricing.



The typical stud parts shown above are used in Packard Rolls-Royce engines and are machined from cold drawn, triple-alloy steel bar stock furnished by PITTSBURGH STEEL COMPANY.

PITTSBURGH STEEL COMPANY
1741 GRANT BUILDING, PITTSBURGH, PA.

PITTSBURGH ALLOY STEEL

BILLETS, BARS, WIRE, TUBING: ALSO CARBON AND STAINLESS STEEL

DoALL Does 8-HOUR JOB in ½ HOUR

The same blanking die that takes 8 hours of tedious drilling and filing to make on the Drill, can be cut by the DoALL in exactly 30 minutes. Not only a 16 to 1 saving in time, but no broken drills, no lost metal.

TRY IT YOURSELF...

If you now use a drill for work of this kind—or a vertical shaper or mill, for that matter—make your own comparative tests and see for yourself how many short cuts DoALL offers in tool room or for regular production work.

If you do not have a DoALL in your plant, one of our factory-trained men will gladly call with a mobile demonstrating unit.

DoALL is today's fastest internal and external method for cutting all metals, alloys, plastics, laminates, wood—blocks a foot thick, bar stock, tubing or stacked sheets.

1. PAINSTAKING CENTER PUNCHING

2. TEDIOUSLY DRILLING ROW OF HOLES

3. HAMMERING OUT THE SLUG

4. FILING OFF THE DRILLMARKS

Write for copy of DoALL ADVANTAGES, the illustrated story of 8 interesting jobs.

DoALL

INDUSTRY'S NEW SET OF TOOLS

CONTINENTAL MACHINES, INC.

5. Washington Ave. Minneapolis 4, Minn.

Sales & Service Offices: Baltimore, Birmingham, Boston, Chicago, Cincinnati, Cleveland, Denver, Detroit, Erie, Grand Rapids, Hartford, Houston, Indianapolis, Los Angeles, Milwaukee, Minneapolis, New York, Orlando, Philadelphia, Pittsburgh, Providence, Rochester, Rockford, St. Louis, San Francisco, Seattle, Toledo, Tulsa.

Kennametal inserts on die and ram
KENNAMETAL
Pin and bearing of Kennametal
Chuck jaws of solid Kennametal
Needle valves and cones tipped with Kennametal
Kennametal-tipped "slow-up" valves
Mortar and pestle tipped with Kennametal
Pump valve ball and seat of Kennametal
Bushings of solid Kennametal
Kennametal contact points

Just to give you an idea . . .

. . . HOW AMERICAN INDUSTRY IS IMPROVING THE PERFORMANCE OF ITS PRODUCTS BY EFFECTIVELY USING KENNAMETAL'S UNIQUE WEAR RESISTANT PROPERTIES—DIMENSIONAL STABILITY, LOW COEFFICIENT OF FRICTION, AND EXTREME RESISTANCE TO ABRASION, CORROSION, EROSION, AND OXIDATION BY ELECTRIC ARCS.

These typical applications are shown to suggest how *you* may employ Kennametal—the metal that masters wear—at critical points in *your* products and production machinery. Kennametal is available in a variety of standard shapes, and it can be accurately molded into many special forms. Particulars are yours for the asking.

KENNAMETAL

SUPERIOR CEMENTED CARBIDES

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KENNAMETAL *Inc.*, LATROBE, PA.

Provide Dependable Power
and Meet
Mechanical Design Specifications

The problem of a well-known manufacturer of business machines was to obtain a motor and a generator that not only provided the correct power to operate extremely sensitive solenoids but also fit the space which was at a premium. Holtzer-Cabot motor development engineers tackled the job and designed a special motor and generator with the proper performance characteristics in special frames which fitted the space specifications . . . and another motor problem was solved.

For over 50 years Holtzer-Cabot has concentrated its energies in designing and building special motors.

Holtzer-Cabot Powered Tabulating Machine

And although today, our plant facilities are devoted entirely to manufacturing special fractional H. P. motors for war products, our development engineers will gladly cooperate with you on your post-war fractional H. P. motor requirements.

Special Motors Designed to Fit the Application

HOLTZER-CABOT

Division of First Industrial Corporation

Designers and Builders of Special Fractional HP Motors and Electrical Apparatus

125 AMORY STREET, BOSTON 19, MASSACHUSETTS • CHICAGO, ILL. • NEW YORK, N. Y. • PHILADELPHIA, PENNSYLVANIA

Why we do less and less welding

The Steel Castings Industry believes in welding—regards it as a very useful art.

The welding process is used to repair steel castings that sometimes come from the mold with slight imperfections—usually mere surface flaws that do not affect the functional value of the casting.

Welding is also used to join castings together, or to other structural members.

But useful as welding is, the Steel Castings Industry is doing less and less of it.

There are two reasons for this trend.

First, research and experience have developed techniques for turning out steel castings that are free from minor imperfections—and no welding to be done.

Second, research and experience have shown the steel founder how to cast more complicated shapes. And certainly it is good economy to handle as few parts as the job will permit, as compared with producing a greater number of parts and joining them together.

It is no reflection on the value of the welding art that the Steel Castings Industry, as the direct result of organized research, has less need for it.

As compared with the standards of just a few years ago, steel castings are vastly better in soundness, finish and utility.

Published by the Steel Founders' Society of America, to tell you about its organized Research Program.

MODERNIZE AND IMPROVE YOUR PRODUCT WITH

STEEL CASTINGS

The ROAD TO MASS PRODUCTION IS SMOOTHED ··· with *Mullins impressions*

THE pathway of the mass production processes of many an American Industry has been smoothed and widened by Mullins' Pressed Metal Designs.

Hundreds of today's streamlined, light but sturdy, low cost devices have benefited by Mullins' design engineering experience and mass production facilities.

A Mullins' Press Engineer is always ready to add his know-how to yours in designing your future products. 'Phone or write for him.

Manufacturers of *Youngstown Kitchens by Mullins*

DESIGN ENGINEERING SERVICE
LARGE PRESSED METAL PARTS
PORCELAIN ENAMEL PRODUCTS

Mullins
MANUFACTURING CORPORATION
SALEM and WARREN, OHIO

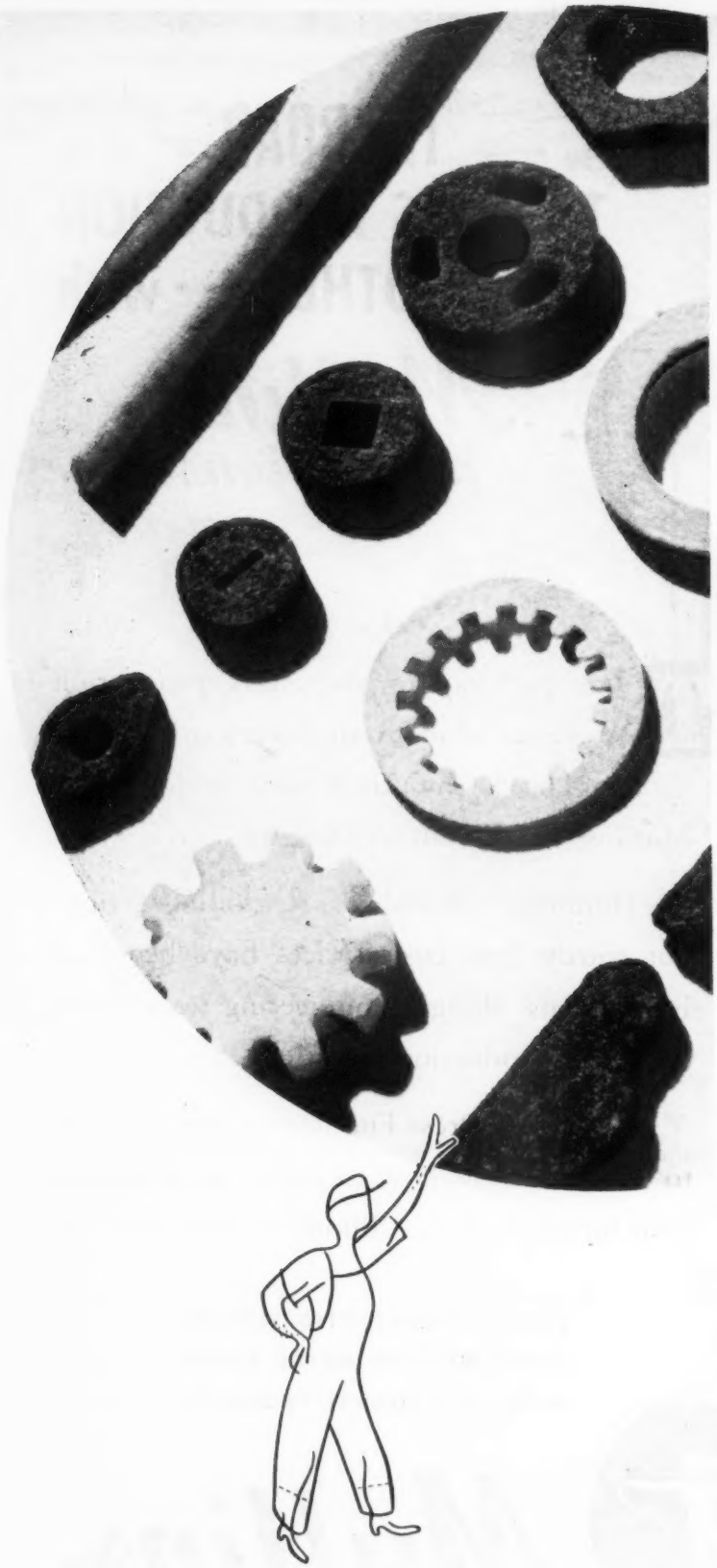
Until the last shot is fired—buy bonds—give blood—salvage fats and paper—work for Victory. Then do your part to . . .

Give a Man a Job

Put Dollars to Work

The FREE American Way

Mullins can PRESS it from METAL instead.



Felters Felt lives a varied life

under all kinds of conditions

Felters Felt is unaffected by normal atmospheric conditions—sun, heat, moisture and cold. It can be treated chemically, will not deteriorate in the presence of oil, and is not adversely affected by water. That is why it is being substituted in more and more cases for rubber and cork.

in all kinds of shapes

Felters Felt cuts cleanly—no ragged edges. It is as soft as a kitten's ear or so hard it requires machining. It has good acoustical properties, and is an excellent vibration isolating medium.

in all kinds of services

Felters Felt is used to keep oil *in* and dirt *out* of bearings; in grinding and polishing operations; for feeding lubricants; for filtering; for padding; and for many other purposes. For the complete story on felt cut parts, write for "Felt as a Design Material."

THE Felters Company

210-D SOUTH STREET • BOSTON, MASSACHUSETTS

Offices: New York, Philadelphia, Chicago, Detroit • Sales Representatives: Dallas, Los Angeles, Nashville, St. Louis, St. Paul
Mills: Johnson City, New York; Millbury, Massachusetts; Jackson, Michigan

Globeiron

Trademark Reg. U. S. Pat. Off.

THE ANSWER

. . . as requested

Globeiron Seamless Tubing has many industrial applications. The high magnetic permeability, uniform ductility, softness, toughness, corrosion resistant properties of Globeiron make it practical housing material for generators and motors. The Electrical and Radio industries use Globeiron extensively. Worked hot or cold, Globeiron permits fabrication into almost any form. Its ductility and toughness make it ideal for severe forming operations.

Globe Steel Tubes Co. offers the services of their engineers, excellent laboratory facilities and production capacity to supply tubing with the exact characteristics you require. Write us today for the story of Globeiron and how it can help you.

• *Housing for generators and motors may be thinner and lighter when made of Globeiron instead of low carbon steel.*

• *Under the microscope Globeiron shows a uniform structure of almost pure ferrite with only occasional patches of pearlite.*

★ STAINLESS TUBES
★ BOILER TUBES
★ GLOBEIRON TUBING
★ GLOWELD TUBES

GLOBE TUBES

★ CONDENSER AND HEAT EXCHANGER TUBES
★ MECHANICAL TUBING

GLOBE STEEL Tubes

5014

GLOBE STEEL TUBES CO., Milwaukee 4, Wis., U. S. A.

PANELYTE*

OFFERS YOU EXPERT COUNSEL

in your own locality

You do not have to "limit your call to 5 minutes." Our sales engineers are at *your* service . . . ready to supply authoritative advice on the use of structural, laminated plastics. The network of strategically located Sales Offices was established to supply any required information *promptly*.

Whether it is a matter of specifying the correct thermo-setting plastic . . . a design problem . . . a structural or insulating application . . . or a question on mass-production facilities for molded or fabricated parts . . . check with the PANELYTE representative in your locality. Not only do these experienced men know what PANELYTE Plastics can do . . . but equally as important what they *cannot* do. They are also familiar with specific applications in your industry. To save time, consult the PANELYTE Office nearest you on any problem involving the immediate or postwar use of thermo-setting laminated materials.

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177 Harris St., N.W.
Atlanta 3, Georgia

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1137 Park Square Bldg.
Boston 16, Mass.

Chicago
230 North Michigan Avenue
Chicago 1, Illinois

Cincinnati
1615-16 Carew Tower
Cincinnati 2, Ohio

Cleveland
813 Union Commerce Bldg.
Cleveland 14, Ohio

Dallas
825 Trunk Avenue
Dallas, Texas

Denver
Speer Blvd. at Lincoln St.
Denver, Colorado

Detroit
419 Boulevard Bldg.
Woodward at Grand Blvd.
Detroit 2, Michigan

Kansas City
901 Fidelity Bldg.
Kansas City 6, Mo.

Los Angeles
418 East Third Street
Los Angeles 13, Calif.

Mexico City
Ave. Madero No. 1, Desp. 314
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Montreal
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Montreal, Canada

New Orleans
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New Orleans, La.

Phoenix
Phoenix, Arizona

St. Louis
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St. Louis, Missouri

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St. Paul 4, Minnesota

San Francisco
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San Francisco 3, Calif.

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Syracuse
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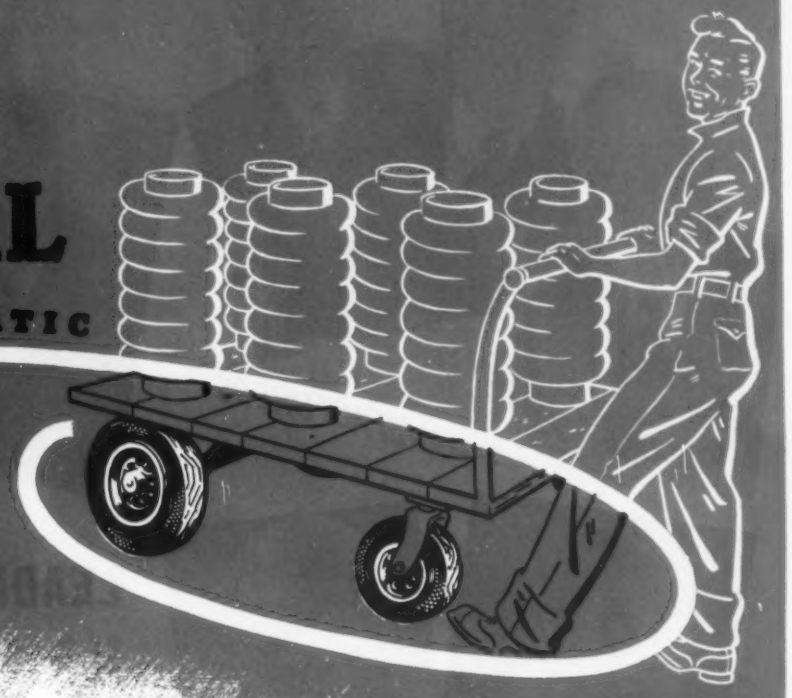

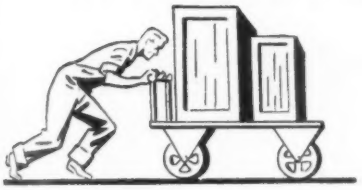

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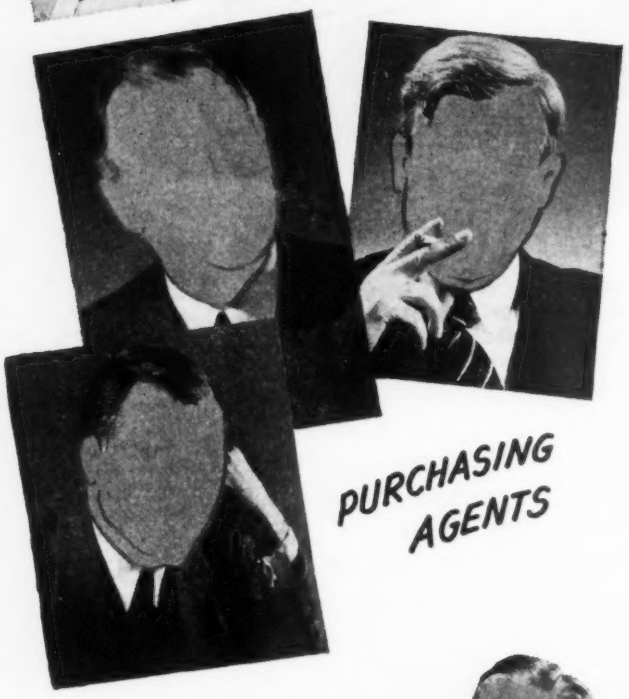

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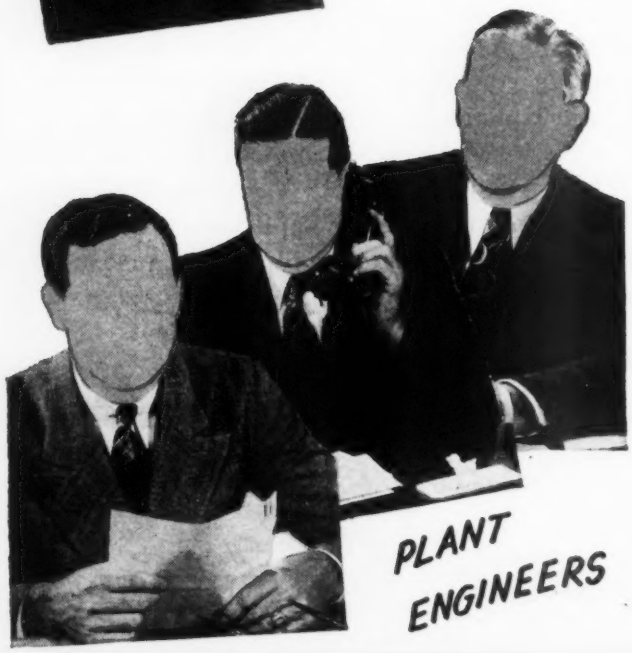

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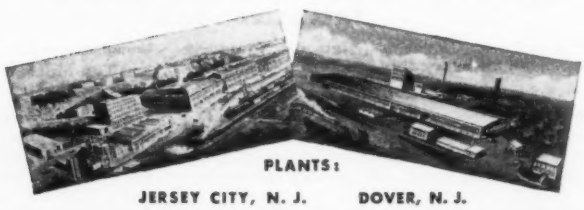

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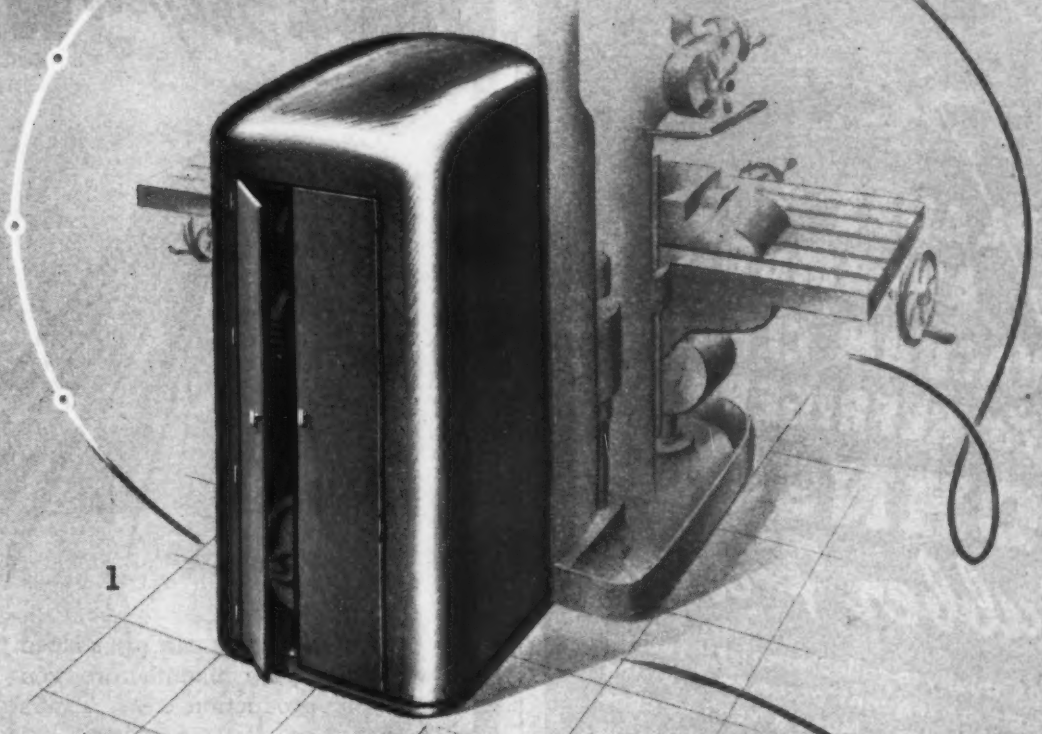

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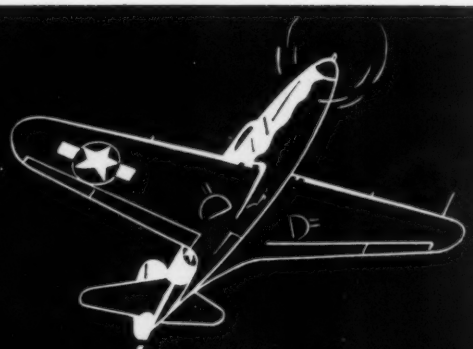

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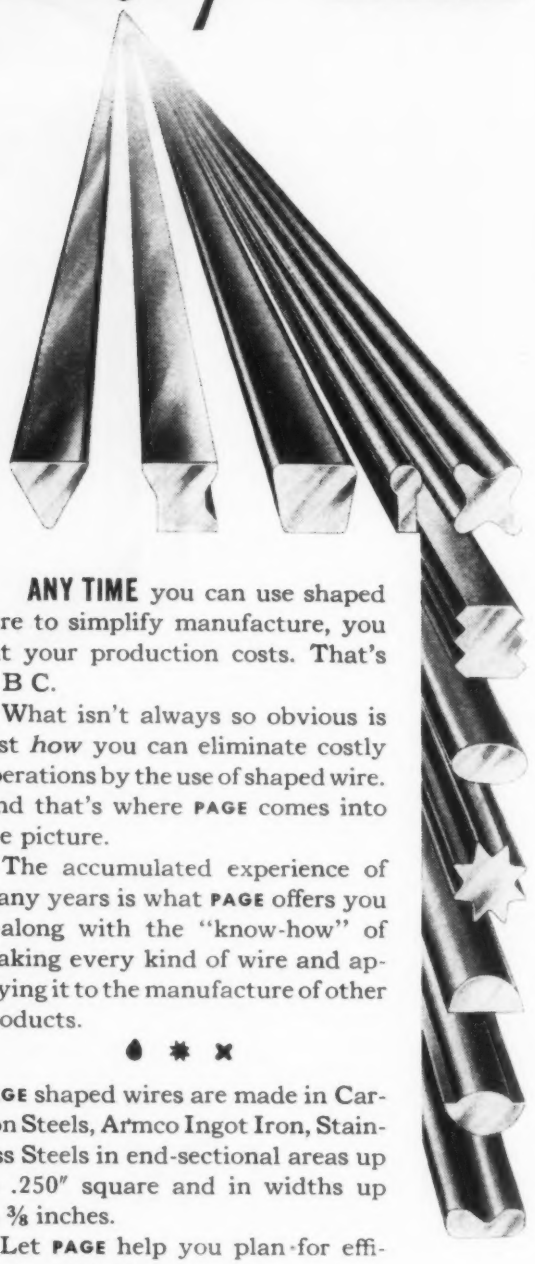

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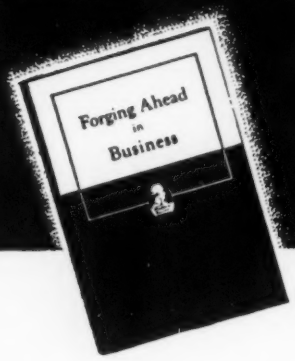

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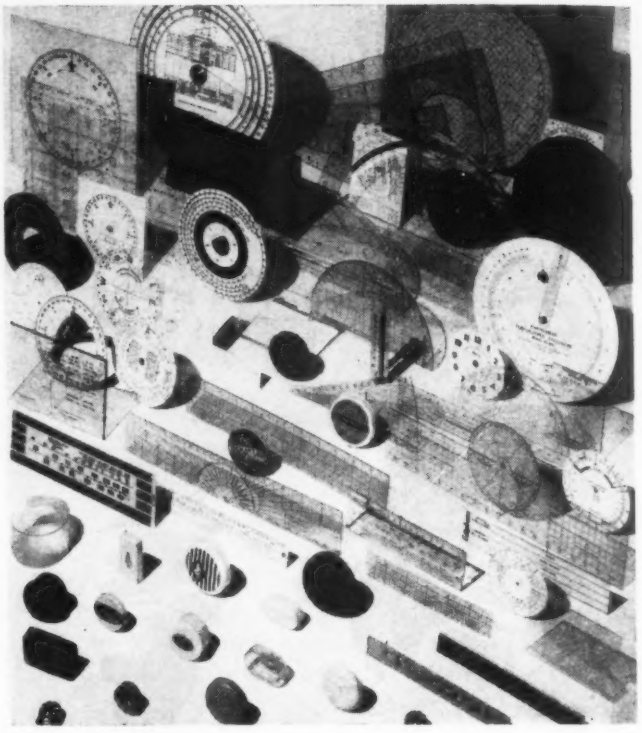

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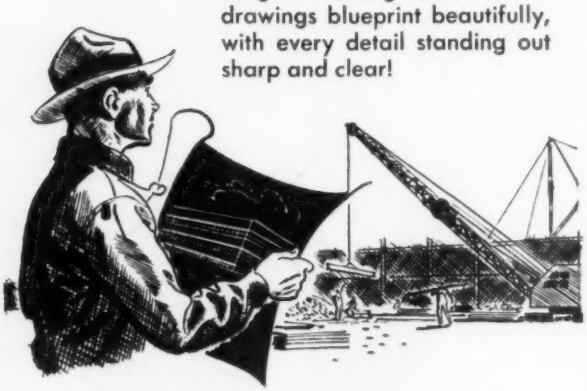

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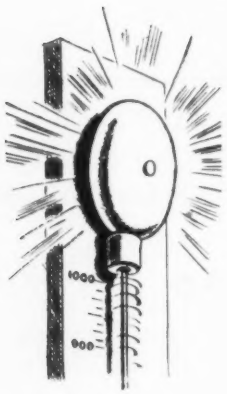

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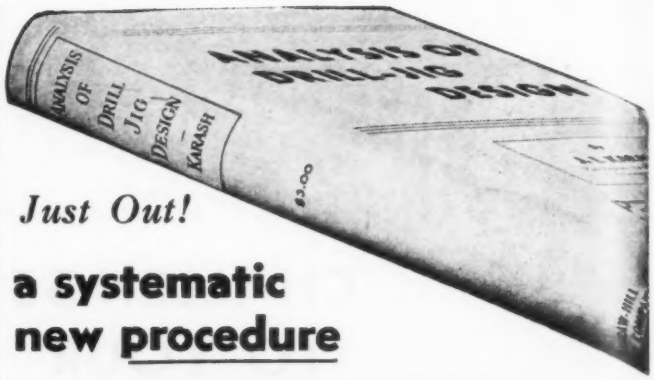

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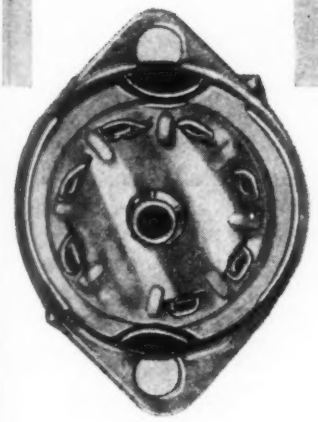

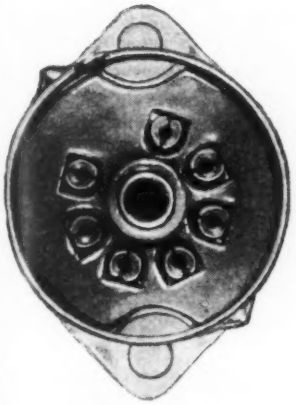

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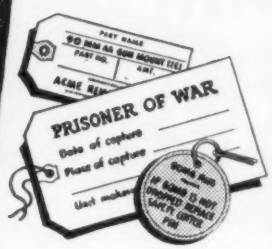

Dennison Tags, with ring and pin assemblies, help arm bombs for use; facilitate by color codes, the salvage of vital metal scrap; identify prisoners; furnish progressive records in the manufacture of carbines, half tracks and tanks —and expedite war production in hundreds of ways.

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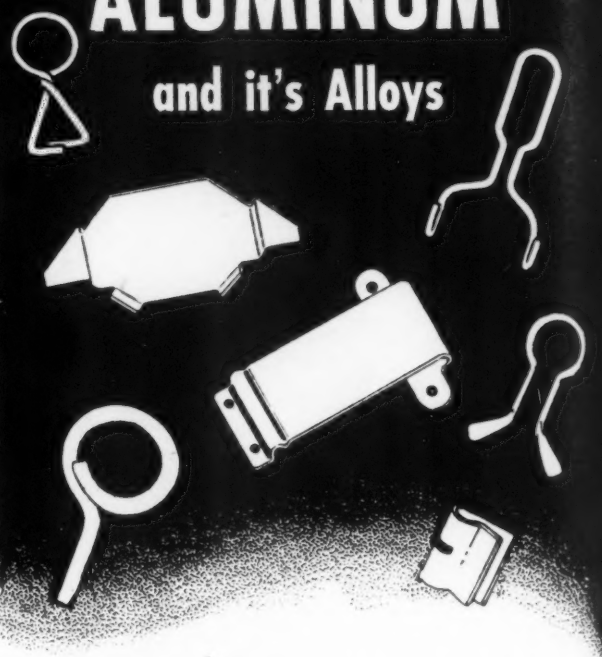

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To retain and improve the strength of aluminum and its alloys requires thorough knowledge of the metal, and of the proper tools for punching and forming. Die clearances, radii limitations with and across the grain, tool finish and stripping methods are extremely important.

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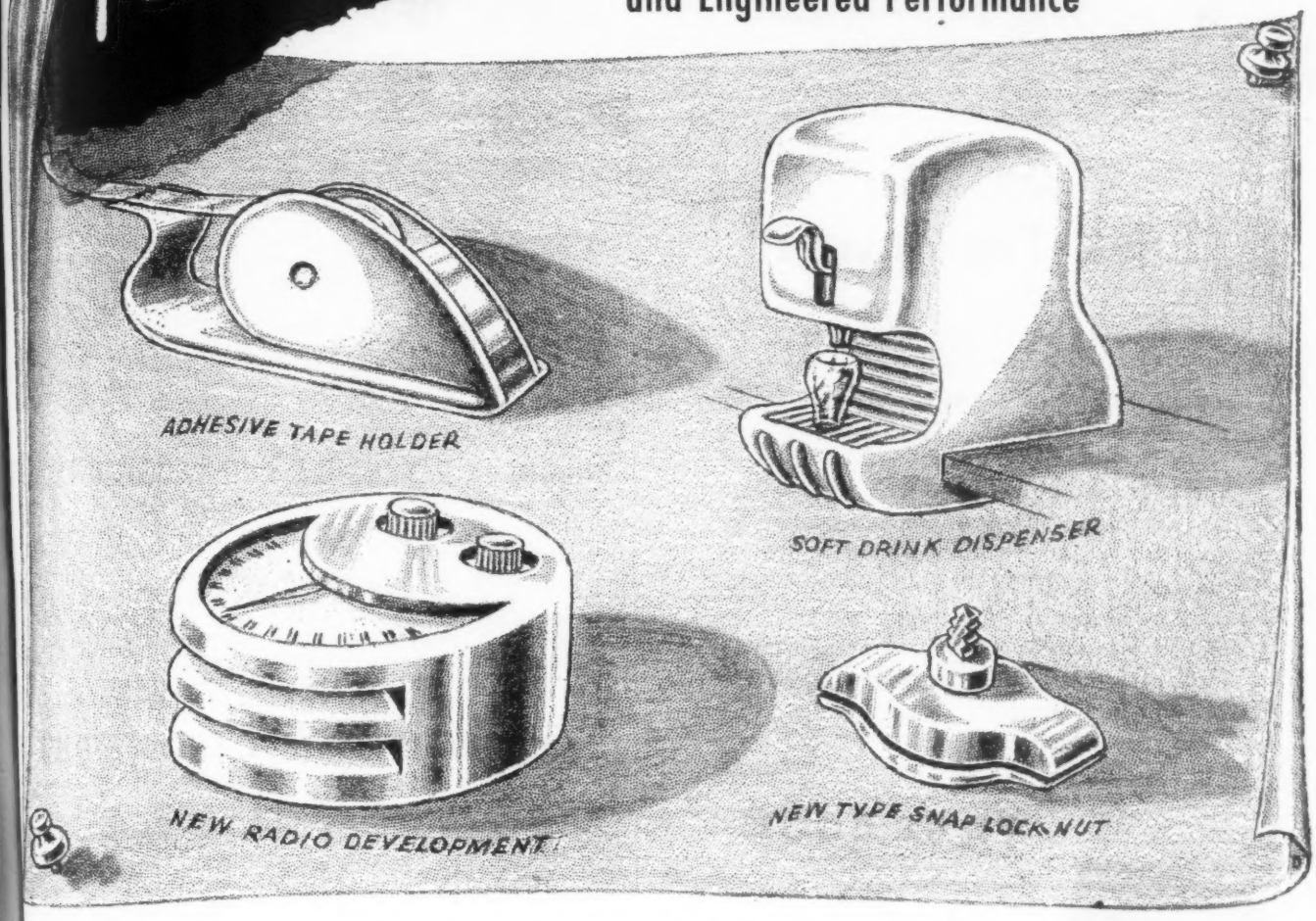

The postwar products sketched are recent achievements product development and improvement created by RAMMES, in collaboration with the customer's staff. These ccomplishments are indicative of the broad services avail-ble for designing, developing, and engineering. Other prod-cts on which we have made interesting developments are hoto-flash reflector, an office device, refrigerator parts, har-onica, vanity cases, and metal giftware creations.

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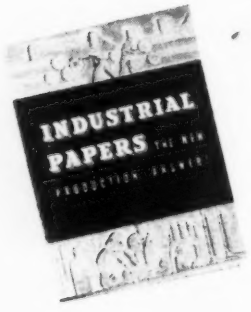

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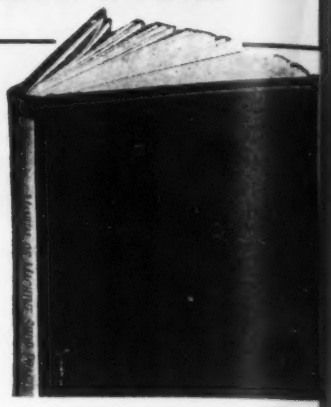

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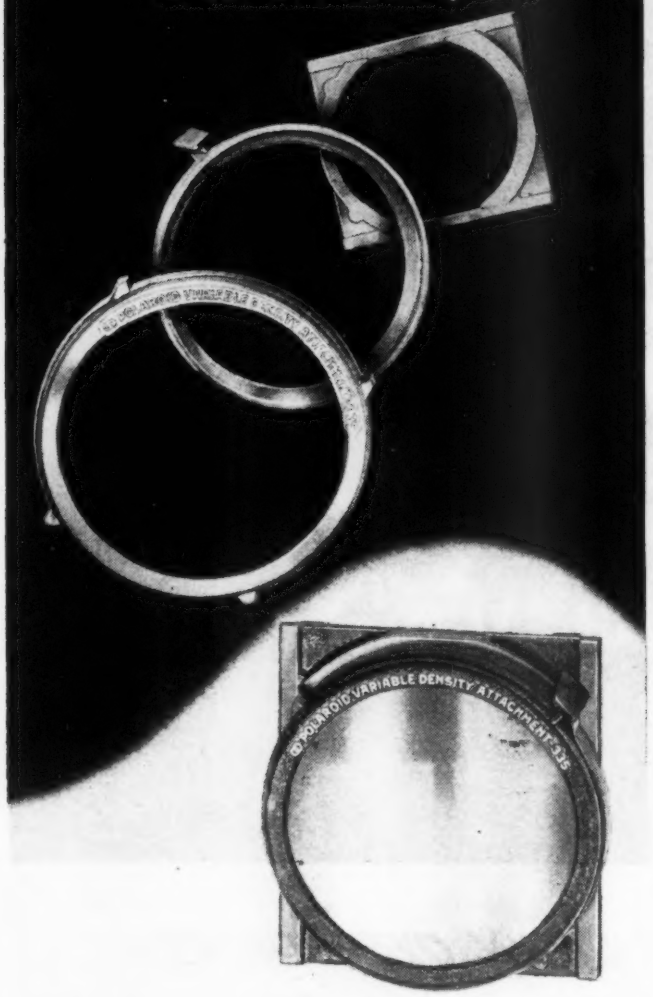

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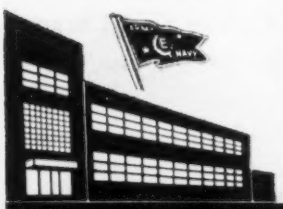

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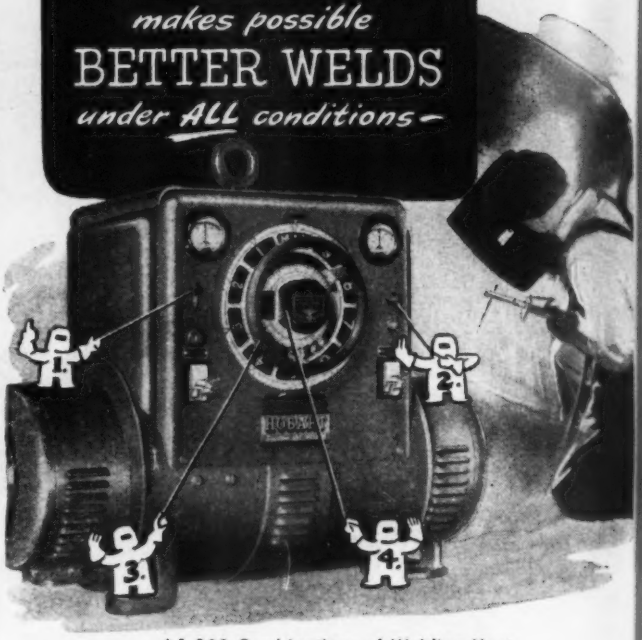

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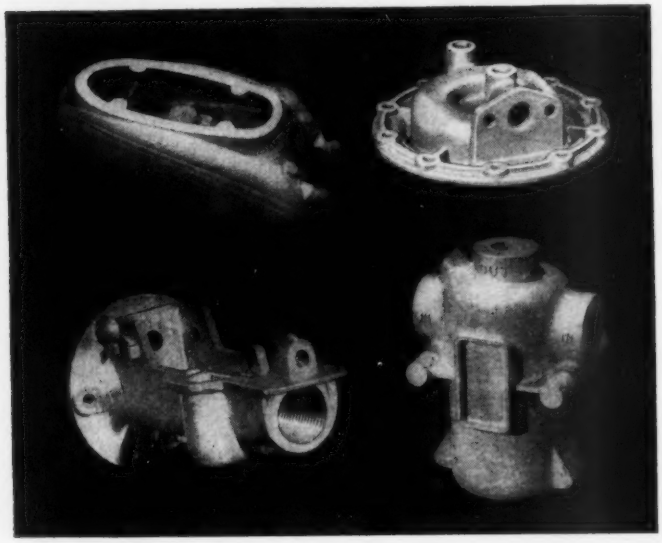

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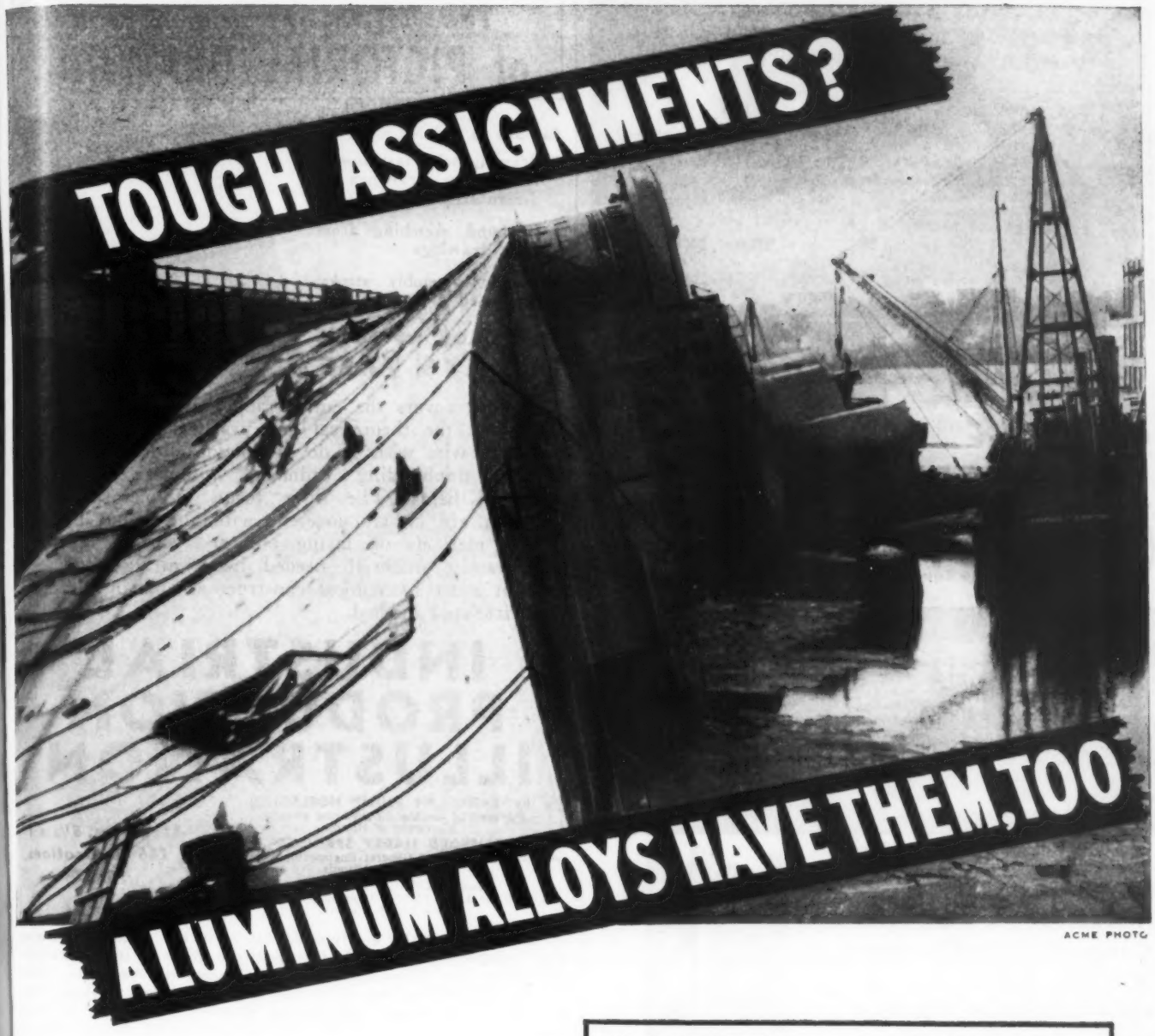

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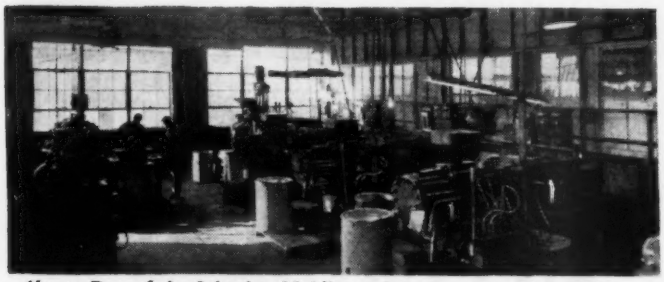

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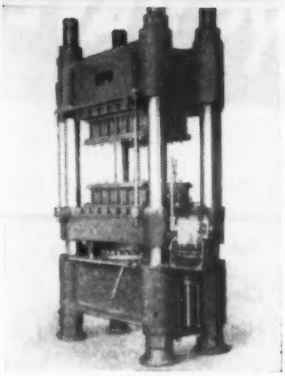

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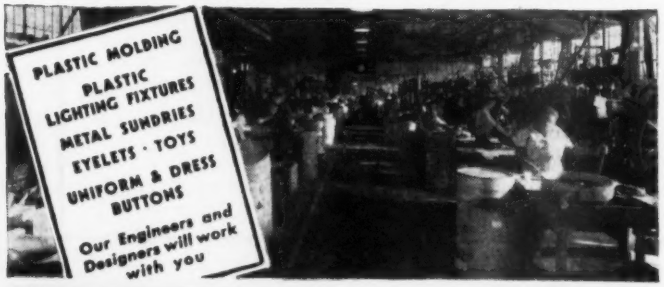

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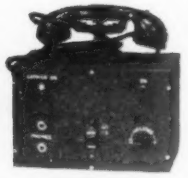

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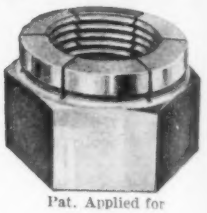

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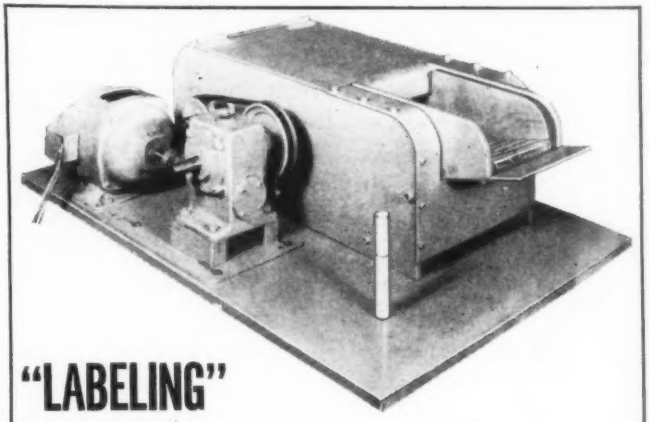

"LABELING"

Without Paper or Glue . . .

Any wording or illustration which can be printed on a paper label to be attached to a cylindrical or conical shaped product can also be printed *directly on the product.*

We design and make the Marking Machines and formulate the special inks to do this work.

If yours is a Marking Problem, let us solve it.

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1800 W. Larchmont Ave.
Chicago 13 Illinois

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Directly
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AMPOULES
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and similar small cylindrical objects made of Plastics, Glass, Wood, Metal, Cardboard.

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Continuous Blueprinting and Processing (Washing, Developing and Drying) Machine has an actual production speed of 20 feet per minute.

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When production can safely be diverted from critical items, engineers will turn to completing plans on new, and design improvements on old products . . . then tracing reproductions again will be in demand in huge quantities.

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✓ **FASTER**... Pease "22-16," illustrated, produces finished blueprints at 20 feet per minute and Pease "22," not shown, has a speed of 30 feet per minute.

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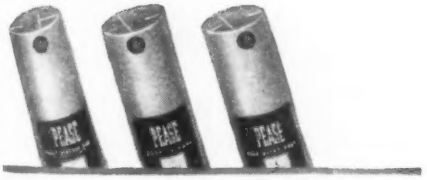

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for use with any Blueprinting or Whiteprinting (Dry Direct Process) machines, are uniformly dependable for producing quality Blueprints, Blueline Prints, Brownprints (Negatives), Brownline Prints and Multazo Whiteprints.

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The new Du-Lite Fact Book is filled with information on Chemifinishes, based on the war time experience of leading industries

Would you spend 15 minutes to improve your Post-War Product? Then Get the Facts about DU-LITE *Chemifinishes* for Steel, Brass, Copper, Zinc

Every manufacturer of metal products faces the problem of what to do about finishes when he gets into the the post-war period. Competition will be of the keenest and modern finishes will pay a large part in the acceptability and attractiveness of finished metal products.

Color will mean a lot in finishes, but durability, rust resistance and cost will always be a deciding factor in the practical choice of finishes for thousands of items.

The new Du-Lite Fact Book tells you frankly and clearly what to expect of black finishes for Steel, Brass, Copper and Zinc. It is a practical handbook for the superintendent and foreman of your finishing division.

A copy will be mailed to you without charge, or to any person in your organization on request. As the edition is restricted, better write promptly.

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Smartly styled, expertly made name and data plates by Robbins bring positive identification, enhanced appearance and an extra advertising plus to any product. Manufacturers of heavy equipment and luxury utilities alike know the multiple advantages obtained from using Robbins Quality Name Plates . . . metal, plastic or metal with enamel.

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WHEN bearings *must not fail* under extreme conditions of vibration and shock, specify Olds Bearing Bronze. This copper-nickel-lead alloy is used for aircraft controls, thrust washers, cowl flap bearings, landing gear operating nuts and instrument bearings.

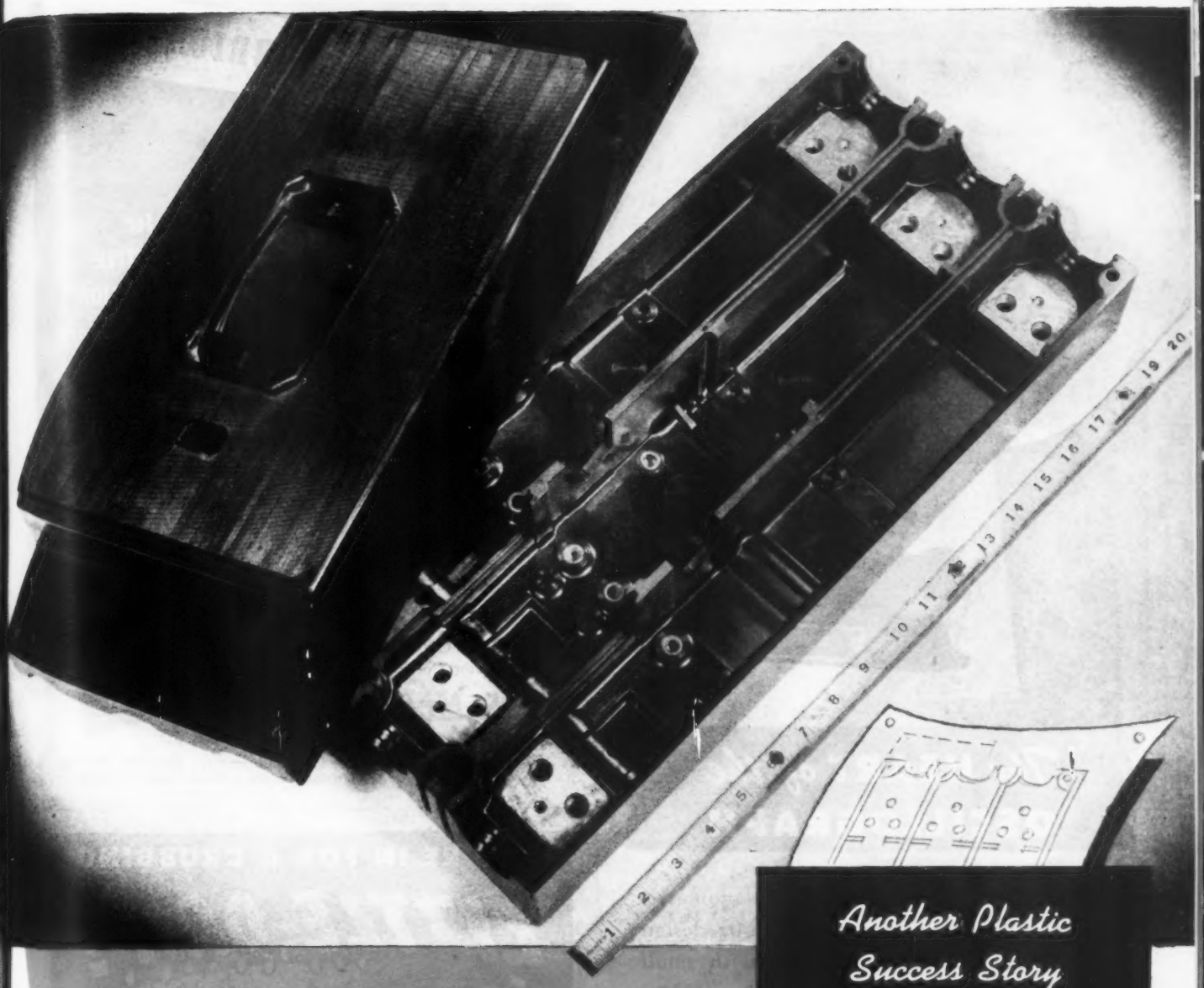
PHYSICAL CHARACTERISTICS

Tensile Strength—psi	22,000
Tensile Yield Strength —at .35% set, psi	16,000
Compression Yield Strength at 35% set, psi	17,000
Elongation in 2"—%	3

Write for Bulletin of specifications, applications and stock sizes.

OLDS ALLOYS
Company
8686 Rheem Ave., Southgate, Calif.
Suburb of Los Angeles

A 20 Inch IDEA... Molded in PLASTICS



Diversity in size and quantity of plastic products produced by Tech-Art run the full commercial scale. In sizes they range from minute highly technical pieces to the very largest units being produced. Numerically these produts are sometimes molded by Tech-Art in relatively small amounts or, as in the case of widely used consumer goods, in quantities that approach box car figures. Every conceivable type of molding practice is performed at Tech-Art, utilizing hand molds, semi-automatic and fully automatic molds in both compression and compression transfer types of molds. In injection molding Tech-Art's facilities include a battery of the most modern injection presses. But back of all these facilities stands Tech-Art's broad experience in product engineering, a highly developed knowledge that assures the success of thousands of plastic products before they ever leave Tech-Art's drafting boards.

Another Plastic Success Story

A nationally known Switch-Gear Manufacturer brought to Tech-Art the problems of molding this twenty-inch long circuit-breaker box. Large and costly molds were required that called for master craftsmanship in mold building. Presses employing great pressure were a "must" in this molding operation. Both, together with the acme of perfection in plastic engineering, were found at Tech-Art. The result—as you see here—another Tech-Art Plastic Success Story.

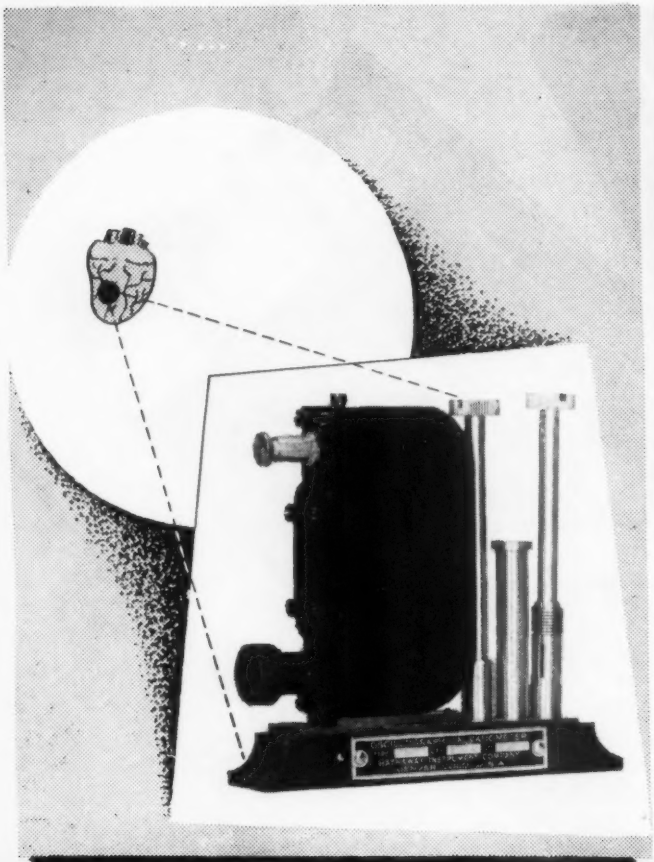
TECHNICAL NOTES: *These pieces, approximately twenty inches long and weighing seventeen pounds, were molded from high impact materials in very large presses. Electric hoists and power knockouts with electronic heating all contributed to the variety of equipment needed to produce these parts.*

TECH-ART PLASTICS COMPANY

36th Ave. and 41st Street • LONG ISLAND CITY, N. Y. • Tel. AStoria 8-6050-1

SUCCESSORS TO BOONTON RUBBER MANUFACTURING COMPANY

PIONEER PLASTIC MOLDERS . . . Established 1891



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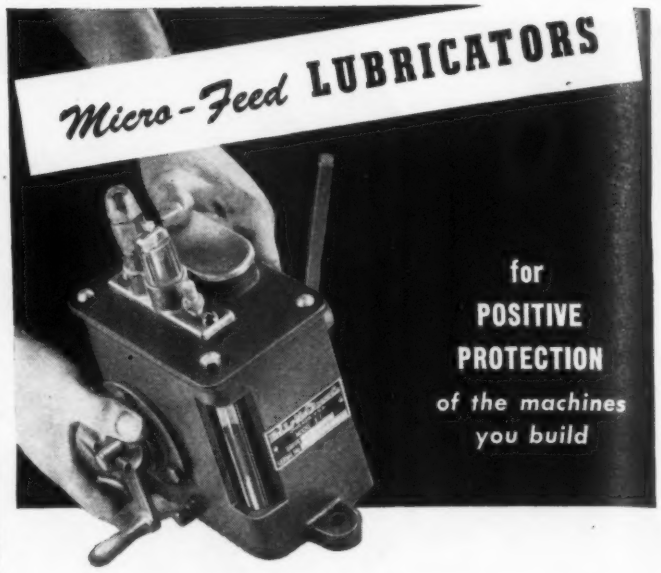
Hathaway Type OA-2 Galvanometers employ a magnetic circuit of unique design which combines *high sensitivity with small size*. Universal mounting 5/8" wide, permits side by side mounting on 3/4" centers . . . means more units per given space.

Moving element and cell window are accessible for easy repairing and cleaning. Wide range of natural frequencies and sensitiveness. High flux density in air gap keeps sensitiveness and natural frequencies at highest peak. Oil tight cell box filled with damping fluid permits operation of galvanometer in *any* position.

Write for Bulletin SP-156. Study the details and learn for yourself the advantages of our Type OA-2 Galvanometer over other types. The Hathaway Instrument Co., 1315 South Clarkson St., Denver 10, Colorado.

Hathaway INSTRUMENTS



A MACHINE will function or fail according to its lubrication. It pays to specify Hills-McCanna force-feed lubricators for such features as: time-proven, single plunger pump principle; internal ratchet drive; improved, corrosion-resistant materials; adjustable; can be understood and maintained by any mechanic. It doesn't pay to skimp on lubricators. WRITE FOR CATALOG L-44 describing lubricators for every requirement.

HILLS-McCANNA COMPANY
3001 N. Western Ave., Chicago 18, Ill.

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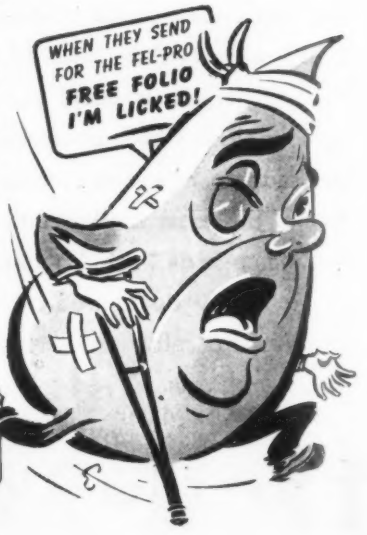

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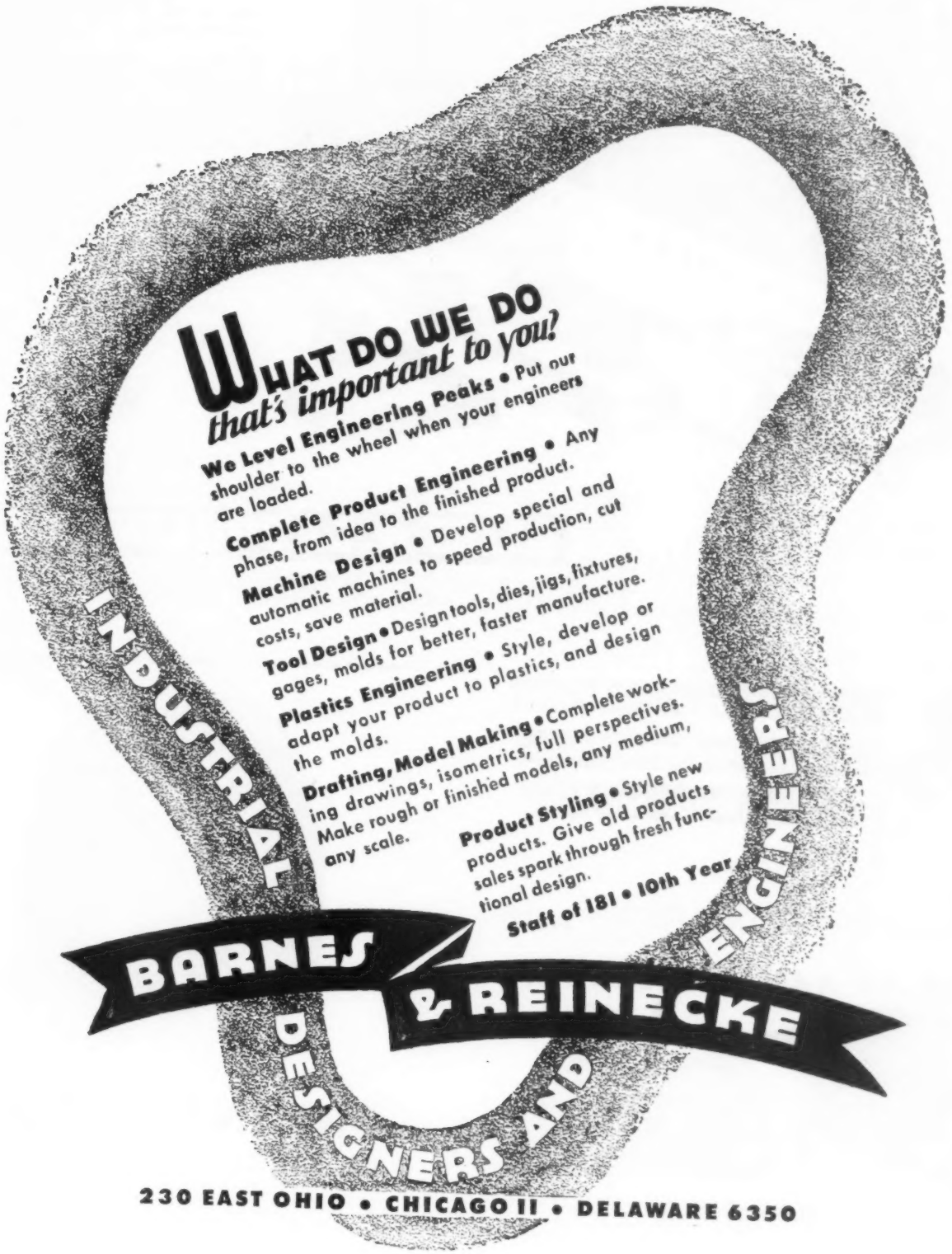
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that's important to you!
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Complete Product Engineering • Any phase, from idea to the finished product.
Machine Design • Develop special and automatic machines to speed production, cut costs, save material.
Tool Design • Design tools, dies, jigs, fixtures, gages, molds for better, faster manufacture.
Plastics Engineering • Style, develop or adapt your product to plastics, and design the molds.
Drafting, Model Making • Complete working drawings, isometrics, full perspectives. Make rough or finished models, any medium, any scale.
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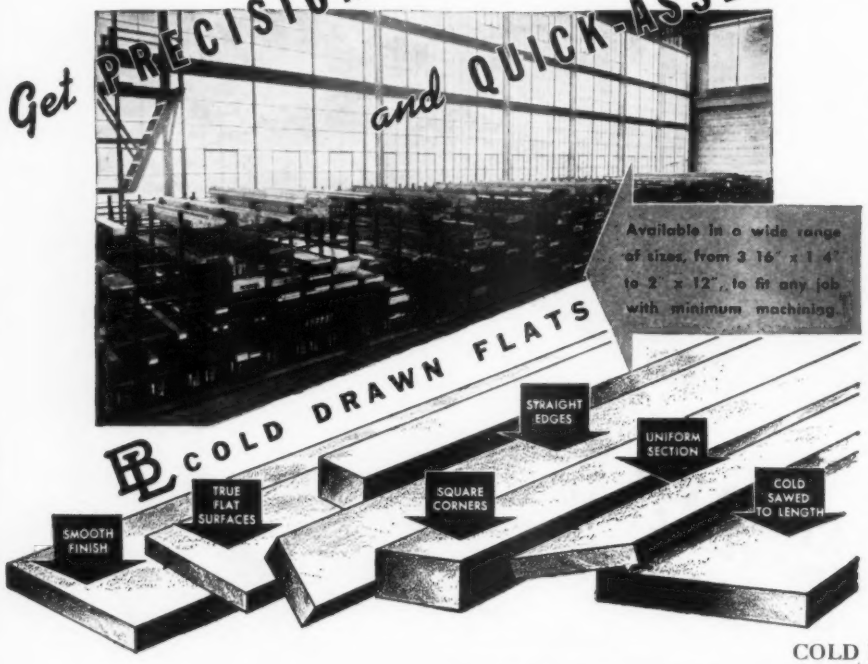

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You can profit by the economies of these accurately made sections.

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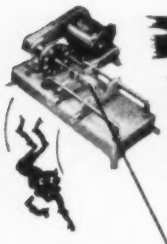
Sales Offices in all Principal Cities



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Illustrates and describes latest Bear Dy-Namic Balancing Machines, embodying latest improvements and refinements. Shows how these machines are being used in over 20 different industries by hundreds of leading companies. Tells why these machines are easier-operating, lower cost. For your copy write Bear Mfg. Co., Ind. Div., Dept. PE, Rock Island, Ill.

BEAR DY-NAMIC BALANCING MACHINES

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OR SMALL PORCELAIN PARTS

Size of part is no limitation to our facilities. We make large single piece insulators weighing 10 lbs. each or small multiple part insulators in carload lot quantities. In each case Universal "dry process" quality controlled manufacturing methods are maintained. What are your insulator specifications?

THE **UNIVERSAL** CLAY PRODUCTS CO.

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Tool Designers and Production Engineers

Tremendous war use of our standard products requires immediate expansion of our facilities for small electric motor production. Product changes and process improvements contemplated to meet growing backlog of civilian requirements insure continuous positions. Location Central Michigan, town having 16,000 population. Reply record of your training and accomplishments. Salary open. P-864, Product Engr.,520N.MichiganAve.,Chicago11

POSITIONS VACANT

WANTED: MECHANICAL engineers for permanent positions in East with established company. Experience in designing corrugated and fibre shipping container machinery desirable. Give complete details as to present work, education, experience, age, draft status, family, salary expected. All replies held confidential. P-814, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

LARGE SOUTHERN aircraft company has position offering excellent post-war future for senior tool designer with four to ten years aircraft or light metal background, experienced in designing main fixtures and jigs. Should be capable of tool planning and group leadership. College education or equivalent desirable. Employment Manager, Bechtel-McCone Corporation, Birmingham, Alabama.

ENGINEERS, MECHANICAL draftsmen and detailers. Midwest manufacturer desires several engineers, mechanical draftsmen and detailers with heavy or excavating machinery experience for design and detail work leading to permanent engineering positions with responsibilities. Excellent post-war opportunity. WMC rules apply. P-824, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

MECHANICAL ENGINEER — Midwest steel company has opening for graduate mechanical engineer. Applicant should have experience in plant layout, machine design and constructions. Give complete record of experience, qualifications, and draft status. Statement of availability required. P-848, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

WANTED—APPLICATION and development refrigeration Engineer by well known manufacturer of condensing units. Permanent job offering wide range of activity and responsibility. Write P-850, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

DESIGN ENGINEER. 2 years university training minimum experienced in development and design of amplifiers and vacuum tube control devices. Good post-war future with progressive Chicago manufacturer. P-851, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

DESIGN ENGINEER Experienced in development and design of small electro-mechanical devices such as timers, special relays and automatic control equipment. Good post-war future with progressive Chicago manufacturer. P-852, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

ELECTRIC SPOT welder experienced in welding aluminum on a Sciaky machine; give complete details. Benson Manufacturing Company—18th & Agnes Avenue, Kansas City, Missouri.

MACHINE DESIGN draftsman: With mechanical engineering education wanted for position in the field of high vacuum technology with progressive rapidly expanding western New York company in new field of industry. Essential, permanent, post-war future of company assured. Experience in machine design, plant layout, manufacturing processes, and development work. Knowledge of machine tool operation and metal trades helpful but not required. Send full statement of qualifications, availability, draft status and photo. Don't overlook this opportunity. P-871, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

WANTED MACHINE designer for permanent position with experience in designing adding, calculating or bookkeeping machines. State experience, salary expected, age and when available. If now engaged in war work, please do not apply. P-872, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

WANTED MACHINE designer, draftsman for permanent postwar positions. We have immediate openings in our development department for designer and draftsman desiring to become connected with a company having assured postwar business in the manufacture of adding, calculating and bookkeeping machines. In reply, state age, education, experience and salary expected. If now engaged in war work, please do not apply. P-873, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

DESIGNER — Experienced in designing cigarette lighters. Salary $12,000 to $15,000. P-874, Product Enginering, 330 W. 42nd St., New York 18, N. Y.

WANTED

DESIGN ENGINEER, familiar with hydraulic mechanisms, by large manufacturer of lifting jacks in Middle West, to head up engineering of complete line of hydraulic jacks. Excellent opportunity, good salary, permanent. Give age, experience, salary in writing. All replies confidential.

P-861, Product Engineering
330 West 42nd St., New York 18, N. Y.

POSITIONS VACANT

HYDRAULIC ENGINEER — unusual opportunity for capable man thoroughly versed in hydro-electric design and installations. P-875, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

WANTED: ENGINEER, experienced in fabricating plain and embossed aluminum articles by forming and rolling sheets and strips, 1/16 to 1/8 inch thickness. Postwar opportunity with strong Philadelphia company entering aluminum field. (Our clients staff know of this advertisement.) Write full details, age, training, experience, salary expected, etc. George Moll Advertising, Philadelphia 34, Pa.

EMPLOYMENT SERVICE

SALARIED POSITIONS — The advertising service of 35 years' recognized standing negotiates for high salaried supervisory technical and executive positions. Procedure will be individualized to your personal requirements and will not conflict with Manpower Commission's. Retaining fee protected by refund provision. Identity covered and present position protected. Send for details. R. W. Bixby, Inc., 268 Delward Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

DEVELOPMENT WORK: Results of independent investigation covering mathematical inter-relationships and determination of properties of metals (critical temperatures, crystal structure, internal stresses, vibration and low-temperature qualities, polarity), available to company interested in development work; services optional on allied research, product development, plant operation, layouts, reports. PW-860, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

PRECISION INSTRUMENT maker with creative ability in research, design and production; excellent knowledge of entire mechanical and electro-mechanical field, seeks connection where ability in the development of new products is needed. Capable of organizing and supervising an experimental department. PW-877, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

MECHANICAL ENGINEER. Wide practical and high technical experience in engineering and development work on medium and high speed machinery. 18 years with large mid-western manufacturer. Desire responsible position near New York City. PW-878, Product Engineering, 330 W. 42nd St., New York 18, N. Y.

DEVELOPMENT-RESEARCH engineer, experienced and resourceful with construction materials and devices. Broad knowledge of practical construction and underlying theory. Can execute projects completely. Now available. Address, P. O. Box 1210, Washington, D. C.

SALESMAN AVAILABLE

SALES ENGINEER salary or drawing account basis or as manufacturers agent. My past experience covers—Chicago area branch office management—estimates—sales and contracts direct and through consulting and project engineers. Covering public utilities—power plant projects, manufacturing and steel industry—refinery and oil and gas industry chemical industry. Will consider territory other than present location. Available January 15th, 1945. SA-881, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

(POSITION WANTED)

Chief Engineer

Twenty years of experience in development, design and production of instruments, special machinery, machine tools, outstanding record as inventor desires connection with progressive, financially sound manufacturer to lead postwar developments, engineering or production. Age 40. Present income $8,400.00.

PW-869, Product Engineering
520 North Michigan Ave., Chicago 11, Ill.

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EXPANDING INDUSTRIAL sales-engineering firm located in Kansas City, Mo. now representing nationally known manufacturers of industrial equipment desires additional industrial accounts. Services offered include sales, sales-engineering and warehousing. Supervision by an experienced business manager and a qualified engineer. RA-880, Product Engineering, 520 N. Michigan Ave., Chicago 11, Ill.

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A prominent, reputable manufacturer of Fabricated Plastics for the Radio, Electrical and Aviation Industries desires additional contracts.

We have also the skilled personnel and manufacturing facilities for handling small electrical and mechanical assemblies, model work and Engineering of Post War Products.

PLASTIC PRODUCTS COMPANY
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Two recent patents of proved merit. Locknut, patent 2,355,253 10 claims, pneumatic conveyor, patent 2,301,350 9 claims.

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If you have a metal product, patented or patent pending, or an invention beyond the idea stage on which you can furnish clear sketches and written description, write us fully about it. We may have an interest in common. Your rights will be scrupulously respected.

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Group of new products ready for production. These are production tools in great demand on airplane production and in all metal working plants. No competition. Engineering details completed. $100,000 investment required. You keep complete control. All inquiries answered.

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(Additional Employment Advertising on pages 344, 345—Business Opportunity Advertising page 344)

NEW PRODUCTS WANTED

By 40 Year Old Manufacturer of

POWER PLANT SPECIALTIES

This manufacturer is an acknowledged leader in his field, has an exceptionally strong financial position and has a nationwide sales organization. He is interested in adding to his line of steam power plant specialties several new products with good postwar sales possibilities. He has a research organization capable of thoroughly testing new products and doing any additional development work found necessary. Write to

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TOOL OR DIE DESIGNERS

Ohio Manufacturer with Die-Cast Division, needs Tool or Die Designers to design Die-Cast Dies, Tools, Jigs, and Fixtures. Broad experience with Machine Tools essential. Some Mechanical and Hydraulic Engineering experience advantageous. Living conditions good in small town, or near-by medium sized city. Excellent post-war opportunities. W. M. C. Rules apply.

P-839, Product Engineering

520 North Michigan Ave., Chicago 11, Ill.

WANTED

ENGINEERING DRAFTSMEN

For design and development of insulation board mill equipment and allied machinery. Permanent position. Experience in design of paper mill equipment helpful but not required. Location South. State draft status and availability with complete details of experience.

P-844, Product Engineering
520 N. Michigan Ave., Chicago 11, Ill.

KEY MEN NEEDED

Men for key positions are needed to continue our expansion for present war contracts and contracts for post war motors. We specialize on all types fractional horsepower electric motors and need men for key positions—

Series Motor Engineer
Induction Motor Engineer
Tool Design Engineer
Manufacturing Supt.
***Also* Tool Draftsman**
Design Draftsman

If you are experienced in any of these lines you can share a very interesting and prosperous future with us.

UNIVERSAL ELECTRIC COMPANY
300 East Main Street Owosso, Michigan
Our employees have the Army Navy "E" Award

WANTED

Production Engineer

Fractional H. P. Electric Motors

Should have specialty background in single phase motors, having devoted major effort to efficient mass production. Line will have limited size range. Engineering design experience desirable for development of motors for tooling and production. Permanent connection with outstanding Southern California manufacturer entering household appliance field. Send detail of experience and personal qualifications to A. W. A., Box 68 Station K, Los Angeles, California.

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WANTED

METAL SPECIALIST

Thorough knowledge metals, broad experience in metal manufacturing and finishing processes. Sales minded to assist sales and service organization on problems arising in field. Our products extremely essential in all kinds of production, processing and maintenance work. Location, N. Y. C. Willing to travel. Give details, experience, age, etc.

P-867, Product Engineering
330 West 42nd St., New York 18, N. Y.

WANTED

ELECTRICAL ENGINEER

Old progressive company 45 years in business offers real opportunity for permanent position and steady advancement for engineer having several years experience in small electric motors. Company is now doing 100% war work and is starting post war planning. Statement of availability, references, and personal status required.

P-859, Product Engineering
330 West 42nd St., New York 18, N. Y.

WANTED

Electro-Plating and Finishing Expert

Thorough knowledge and broad experience in electro-plating and metal finishing processes. Wanted to work with well established sales and service organization manufacturing products extremely essential in all kinds of production, processing and maintenance work. Location, N.Y.C. Must be willing to travel. Permanent. Give full details.

P-866, Product Engineering
330 West 42nd St., New York 18, N. Y.

WANTED

DRAFTSMAN

By electrical company manufacturing motor driven electric appliances 45 years in business. Real opportunity is offered permanent position and steady advancement. Company now engaged in 100% war work and starting post war planning. Statement of availability, references, and personal status required.

P-858, Product Engineering
330 West 42nd St., New York 18, N. Y.

WANTED

By

RBM Manufacturing Co.

Division of Essex Wire Corp.

Logansport, Ind.

DESIGN LAYOUT DRAFTSMAN
PRODUCT DESIGNERS
ELECTRICAL ENGINEERS

These positions offer real opportunities for advancement now and in the post-war era to those men who can design:

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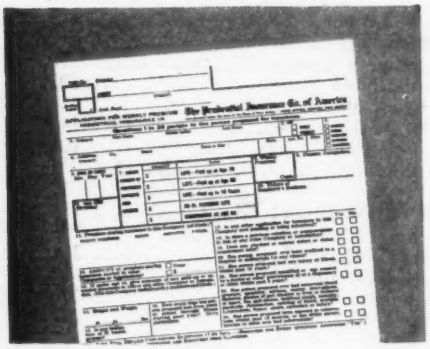

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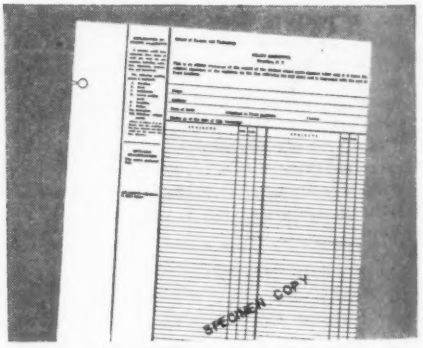

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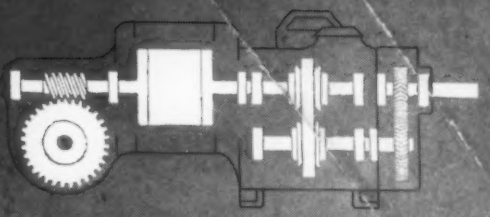

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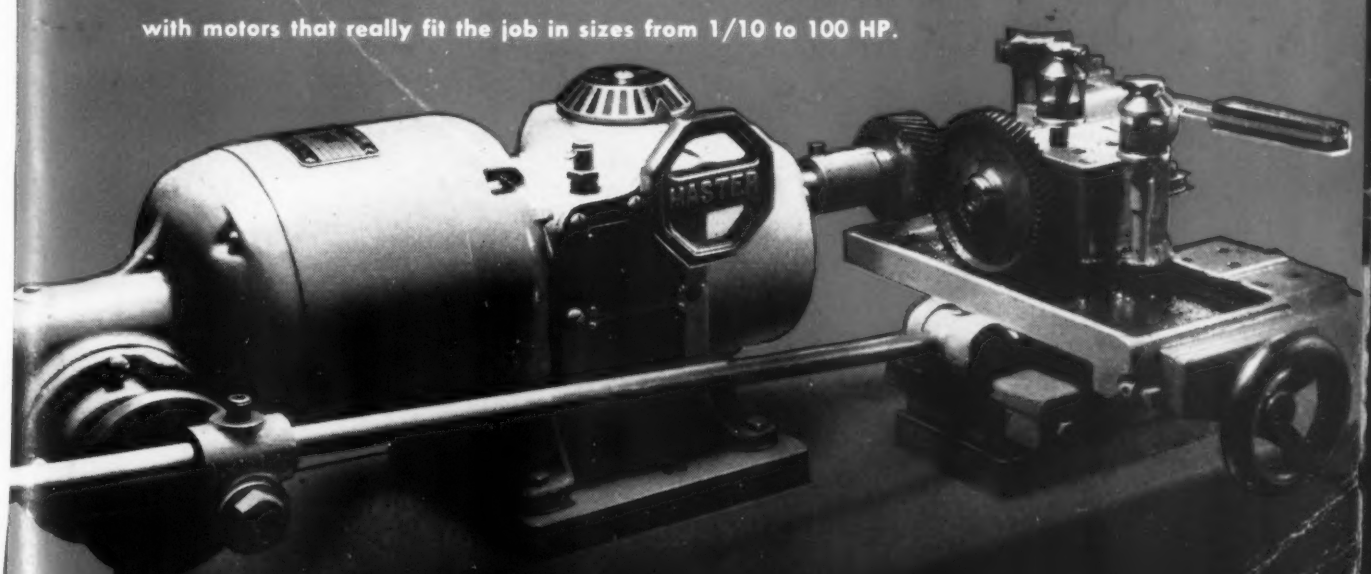

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IRON AND STEEL DIVISION
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November 10, 1944

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President

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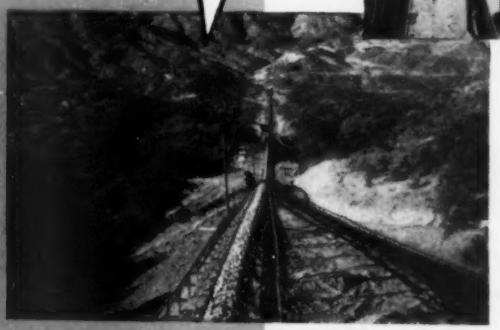

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